DELL POWERVAULT MD32XXI / MD36XXI DEPLOYMENT GUIDE FOR VMWARE ESX4.1 SERVER SOFTWARE

A Dell Technical White Paper
Version 1.5

PowerVault MD32xxi and MD36xxi Storage Arrays

www.dell.com/MD32xxi

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TERMINOLOGY/GLOSSARY

VD == virtual disk

VM == virtual machine

NIC == network interface card

MPIO == Multi-Path I/O

SAN == Storage Area Network

RDM == Raw Device Map

DVS == Distributed Virtual Switch

HA == high availability

DRS == Distributed Resource Scheduler

MRU == Most Recently Used

IQN == iSCSI Qualified Name

INTRODUCTION

These steps necessary to connect to an iSCSI SAN are documented in VMware's iSCSI SAN Configuration Guide which can be found on VMware's website. This whitepaper goes into depth with configuration examples for connecting to a Dell™ PowerVault™ iSCSI SAN utilizing the software iSCSI initiator inside the VMware® ESX4.1 Server™. Additionally, Appendix A gives details regarding configuring hardware initiators from within VMware® ESX4.1 Server™.

The Dell™ PowerVault™ MD32xxi & MD36xxi iSCSI SAN storage solution consists of either a standard or high availability configuration. The standard (simplex) configuration has a single controller with four 1GbE ports. It can be deployed to support up to 32 hosts non-redundantly. The high availability (duplex) configuration has dual controllers with four 1GbE ports per controller for a total of eight 1GbE ports. The dual controller option can also connect up to 32 fully redundant hosts

Provisioning of MD32xxi storage in a VMware® ESX4.1 environment is a multi-step process starting with establishing the iSCSI session, definition of the server topology for host access, and finally allocating storage to the individual virtual machines (VMs).

VMware® vSphere4™ offers many new and advanced enhancements over the iSCSI software initiator in conjunction with iSCSI SAN connectivity. Many of these new features require advanced configuration in order to work properly. Administrators who are familiar with ESX 3.5 iSCSI SAN configuration may find that their current configuration steps are not sufficient to enable all of the advanced features offered in vSphere4.

NEW FEATURES IN VSPHERE4 SOFTWARE ISCSI INITIATOR

VMware vSphere4 ESX4.1 has new support for various new advanced capabilities that were not found in ESX 3.5. This whitepaper will cover the new features in the iSCSI software initiator as well as how to configure them to connect to the SAN.

iSCSI Software Initiator – With ESX4.1, the iSCSI software initiator was re-written from the ground up for better performance and functionality.

Jumbo Frames – With ESX 4.1 and vSphere4, Jumbo Frames can be enabled on the iSCSI software initiator. Jumbo Frame support allows for larger packets to be transferred between the ESX4.1 servers and the SAN for increased efficiency and performance. Jumbo Frame Support can be enabled via the vCLI.

MPIO – With ESX4.1 and vSphere4, customers can benefit from Multi-Path I/O from the ESX4.1 server and the SAN. This allows for multiple connections to be used to allow for greater bandwidth. This is especially important for the PowerVault SAN as each PowerVault member has multiple connections and now ESX4.1 can take full advantage of these connections.

Third Party MPIO Support – With ESX4.1 and vSphere4, VMware has provided an architecture that enables PowerVault platforms to provide new and advanced intelligent integration.

SUPPORTED HARDWARE AND SOFTWARE

HARDWARE REQUIREMENTS

Refer to the following VMware website for a complete up-to-date list of the prerequisites for installing VMware ESX server.
http://www.vmware.com/pdf/vsphere4/r41/vsp_41_esx_server_config.pdf

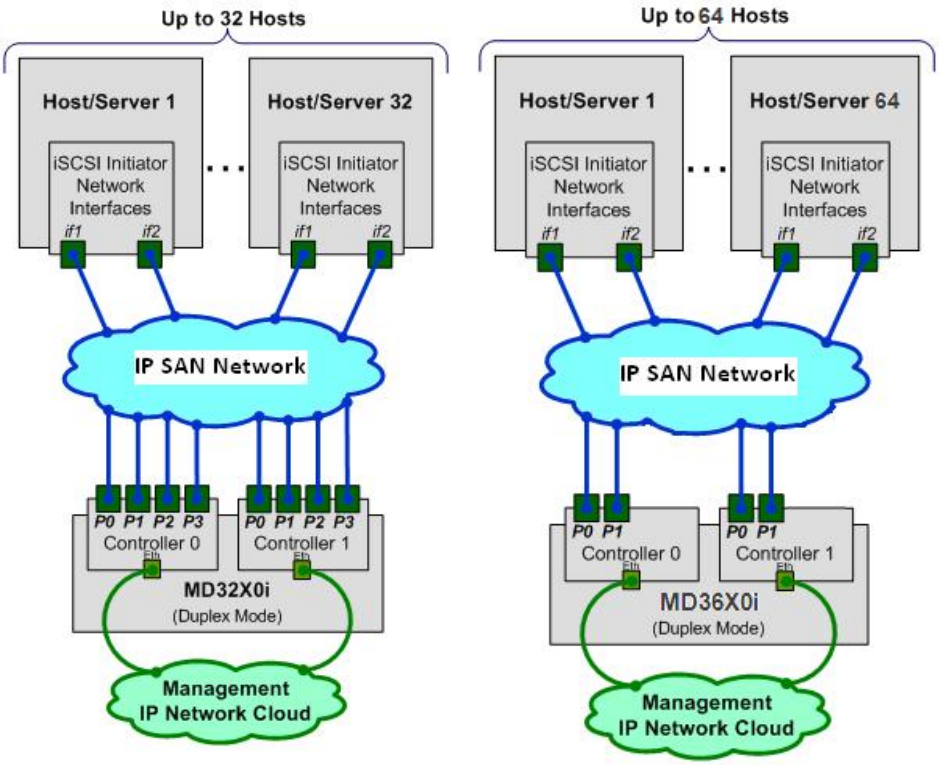
SUPPORTED OPERATING SYSTEMS FOR MD32XXI ARRAY

ESX4.1 is the only supported VMware OS for MD32xxi.

ARCHITECTURAL SETUP

As a best practice, Dell recommends using a separate Gigabit Ethernet network switch to handle iSCSI storage traffic, see PowerVault MD32x0i IP SAN Best Practices. An IP SAN consists of one or more hosts, connected to one or more storage arrays through an IP network, utilizing at least one switch in the network infrastructure. Each switch in the configuration has a path to the MD32XXi via duplex quad-port controllers.

There are many ways to implement an IP SAN based on need, available resources and intended application. Some general rules can be used when designing your IP SAN. For example, in order to maximize the performance of your storage arrays, all host ports can be utilized. Nothing requires you to use all four ports for a given server. If you choose to use all four ports then they need to be on separate subnets. You certainly could only use two of the ports if that meets your IO requirements. Later in this whitepaper we include an in-depth explanation regarding why we might want to use multiple subnets.



CONSIDERATIONS WHEN USING ISCSI SOFTWARE OR HARDWARE INITIATORS FOR ESX4.1 ON THE MD32XXI STORAGE ARRAY

Taking advantage of all of these new features requires some new steps to be taken by ESX administrators. Configuration is done via either GUI or vCLI inside ESX4.1 vCenter. The remainder of this whitepaper focuses on installation and configuration of an iSCSI software initiator connection to a PowerVault Series SAN. Each of these commands can be found inside the VMWARE ISCSI SAN CONFIGURATION Guide and where names and IP Addresses are used, they will be different for each environment. This serves as an example and demonstration of how to configure a new vSphere4 ESX4.1 server correctly and connect it to the PowerVault SAN. The screenshots displayed in this whitepaper are for reference only and may vary from site specific implementations.

ESTABLISHING SESSIONS TO A SAN

Before continuing the examples, we first must discuss how VMware ESX4.1 establishes its connection to the SAN utilizing the new vSphere4 iSCSI Software Adapter.

With previous versions of ESX, sessions were established using a single NIC path and any additional NICs were there for failover only. With the improvements to vSphere4 and MPIO, administrators can now take advantage of multiple paths to the SAN for greater bandwidth and performance. This does require some additional configuration which is discussed in detail in this whitepaper.

VMware uses VMkernel ports as the session initiators. Each VMkernel is bound to a physical adapter. Depending on the environment this can create a single session to an array or up to 8 sessions (ESX4.1 maximum number of connections per volume). For a normal deployment, it is acceptable to use a one-to-one (1:1) ratio of VMkernels to physical network cards. This means if there are 3 physical NICs, you would establish 1 VMkernel per physical NIC and associate a separate NIC with each VMkernel port.

This scheme can be expanded depending on the number of NICs you have in the system. As the environment grows, you can establish multiple sessions to the SAN by oversubscribing VMkernel ports to actual physical NICs. This establishes multiple sessions to an array but still utilizes the same physical NICs as the means to get to the storage. However, VMWare reports issues with oversubscribing VMkernel ports. Consequently we recommend maintaining 1:1 port binding.

Once these sessions to the SAN are initiated, the VMware NMP will take care of load balancing and spreading the I/O across all available paths.

The following assumptions are made for these examples:

1. Running ESX4.1

2. Running latest Dell PowerVault MD32xxi firmware

3. More than one Network Interface Card (NIC) set aside for iSCSI traffic

4. No Distributed Virtual Switch (DVS) for iSCSI traffic

5. The MD32xxi IP address on the host ports will have already been configured, see PowerVault MD32x0i IP SAN Best Practices

6. The network topology is connected and both the ESX server and MD32xxi are powered on.

7. The environment will be using multiple NICs and attaching to a Dell PowerVault SAN utilizing Native Multipathing (NMP) from VMware.

CONFIGURE ISCSI STORAGE ON ESX4.1 SERVER - INSTALLATION STEPS

Not every environment requires all of the steps detailed in this example.

Users connecting their vSphere4 environment using just iSCSI HBAs or users wishing to only assign a single iSCSI NIC with no Jumbo Frame support will not follow these steps and instead configure their environment as normal. Users who wish to only enable

Jumbo Frame support for their environment will want to take note of steps 1 and 2 but only create a single VMkernel port through the vCenter GUI after that.

Users wishing to only enable Jumbo Frame support for the iSCSI connection need to follow steps 1 and steps 2 with the following changes:

Step 1: Configure vSwitch and Enable Jumbo Frames – No changes to the instructions

Step 2: Add iSCSI VMkernel Ports – Instead of assigning multiple VMkernel Ports, administrators will only assign a single VMkernel Port

Once these two steps are done, the rest of the configuration can be accomplished in the vCenter GUI by attaching NICs, assigning storage and then connecting to the storage.

CONNECT TO THE ESX SERVER/VCENTER USING VI CLIENT AND FOLLOW THE STEPS BELOW.

STEP1: CONFIGURE VSWITCH & ENABLE JUMBO FRAMES

This step will create a new vSwitch and enable Jumbo Frame support for this switch. Currently there is no option to enable Jumbo Frames on a vSwitch from VMware vCenter GUI so these commands must be run via vCLI. Be sure to check the environment to make sure that Jumbo Frames are supported at the networking layer before enabling it on the ESX host.

The following command will create a new vSwitch called vSwitch2:

esxcfg-vswitch –a vSwitch2

Next, enable Jumbo Frames on the vSwitch:

esxcfg-vswitch –m 9000 vSwitch2

To verify that the switch was configured properly run the following command:

esxcfg-vswitch –l

Your output will look similar to this:

Switch Name	Num Ports	Used Ports	Configured Ports	MTU Uplinks
vSwitch2	64	1	64	9000

You can note the new vSwitch2 with the MTU of 9000 to verify that the switch was created correctly. You can also see it displayed in the GUI of vCenter. Throughout these procedures some of the verification can be done via command line or seen in the vCenter GUI. The polling rate of vCenter is not instant so changes will not show up immediately after it is typed.

STEP2: ADD ISCSI VMKERNEL PORTS

This next step will assign VMkernel Ports to the new vSwitch2. It will also configure Jumbo Frame support as well as assign the IP Addresses. Administrators familiar with iSCSI connectivity in ESX3.5 will find that it is no longer required to configure a Service Console port for the iSCSI connection. Another thing to notice is that because the Service Console is not needed, the iSCSI switch environment can be on a different subnet than the public environment or existing service console. Each VMkernel Port will need its own IP Address and they must all be on the same subnet as the PowerVault IP Address. Nothing requires you to use all four ports for a given server but if you are going to use Round Robin (RR) then using all four ports is recommended. If you choose to use all four ports then they need to be on separate subnets and if you need to use vLans you'll need separate vLans for RR to work correctly. You certainly can only use two of the ports if that meets the IO requirements.

There are some suggested configurations depending on the number of NICs that will be used for iSCSI traffic. Every environment will differ depending on the number of hosts, and the number of volumes.

In a default configuration assign one VMkernel port for each physical NIC in the system. So if there are 3 NICs, assign 3 VMkernel Ports. This is referred to in VMware's iSCSI SAN Configuration Guide as 1:1 port binding.

VMware vCenter has a maximum of 8 connections to a single volume. In this whitepaper we choose 3 connections in the 1:1 scenario. This provides scalability and performance as the SAN environment grows without having to make changes on each ESX host.

If fewer connections are desired follow the above sample configurations to obtain the number of VMkernel Ports that match the environment and the number of paths you need.

Always keep the entire virtual datacenter in mind when deciding on path and volume count. View the Release Notes of the PowerVault Firmware for the current connection limits for the Dell PowerVault.

All of these configurations are done for the vSwitch itself. This means that once it is done, the ESX4.1 host will create multiple connections to the PowerVault SAN. Once this is configured there only need to be changes made if more NICs are being added or if more or less paths are needed.

Note: Host profiles do not keep information on Jumbo Frames or Port Bindings.

For the rest of this example the configuration steps and commands will be given for the 1:1 binding.

The following command will add a new iSCSI VMkernel Port named iSCSI1 on the vSwitch created in the previous step.

esxcfg-vswitch –A iSCSI1 vSwitch2

This next command will configure the IP Address, Subnet Mask and enable Jumbo Frame support for the new VMkernel Port iSCSI1

esxcfg-vmknic –a –i 10.10.6.206 –n 255.255.255.0 –m 9000 iSCSI1

For our example with a 1:1 relationship with 3 NICs we need to create 2 more VMkernel Ports named iSCSI2 and iSCSI3

esxcfg-vswitch –A iSCSI2 vSwitch2

esxcfg-vmknic –a –i 10.10.7.207 –n 255.255.255.0 –m 9000 iSCSI2

esxcfg-vswitch –A iSCSI3 vSwitch2

esxcfg-vmknic –a –i 10.10.8.208 –n 255.255.255.0 –m 9000 iSCSI3

To verify the configuration enter the following command:

esxcfg-vswitch –l

The output will look similar to this:

Switch Name	Num Ports	Used Ports	Configured Ports	MTU	Uplinks
vSwitch2	64	7	64	9000	

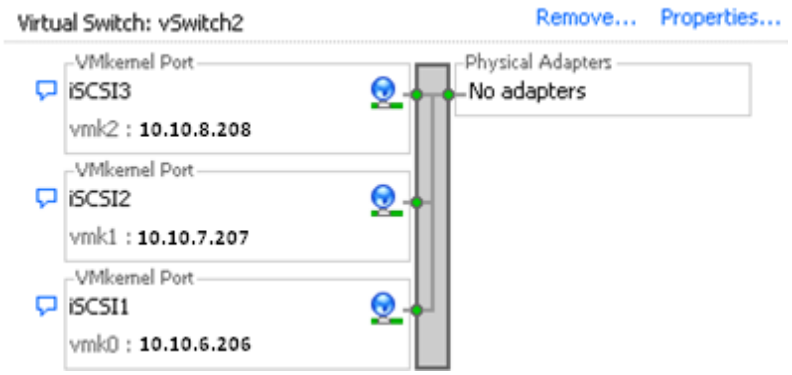
PortGroup Name	VLAN ID	Used Ports	Uplinks
iSCSI3	0	1	
iSCSI2	0	1	
iSCSI1	0	1	

This will show the VMkernel ports that are assigned to the vSwitch. To verify the IP addresses enter the following command:

esxcfg-vmknic –l

The output will look similar to the graphic below.

You can also verify the IP Addresses via the vCenter GUI. In vCenter, on the ESX Host, navigate to ***Configuration -> Networking***.



STEP3: ASSIGN NETWORK ADAPTERS

The next step in the process is to assign the network adapters (NICs) that will be attached to the iSCSI network and used for iSCSI traffic. These will be attached to the vSwitch2 that we created earlier. This can be done two ways, in the vCenter GUI or by vCLI.

To list all of the adapters in the system run the following command:

esxcfg-nics –l

The output will look similar to this:

Name PCI Driver Link Speed Duplex MAC Address MTU

vmnic0 03:00.00 bnx2 Up 1000Mbps Full 00:21:9b:8b:4b:b0 1500

This will list all of the adapters in the system. Assign the NICs that are physically connected to the SAN infrastructure and to the vSwitch. The following command assumes that we are assigning vmnic1, vmnic2, and vmnic3 to the vSwitch.

esxcfg-vswitch –L vmnic1 vSwitch2

esxcfg-vswitch –L vmnic2 vSwitch2

esxcfg-vswitch –L vmnic3 vSwitch2

Once again, to verify the configuration type the following command to list the vSwitch information:

esxcfg-vswitch –l

Your output will look similar to the following. Note the new vmnics that were assigned to the vSwitch under uplinks.

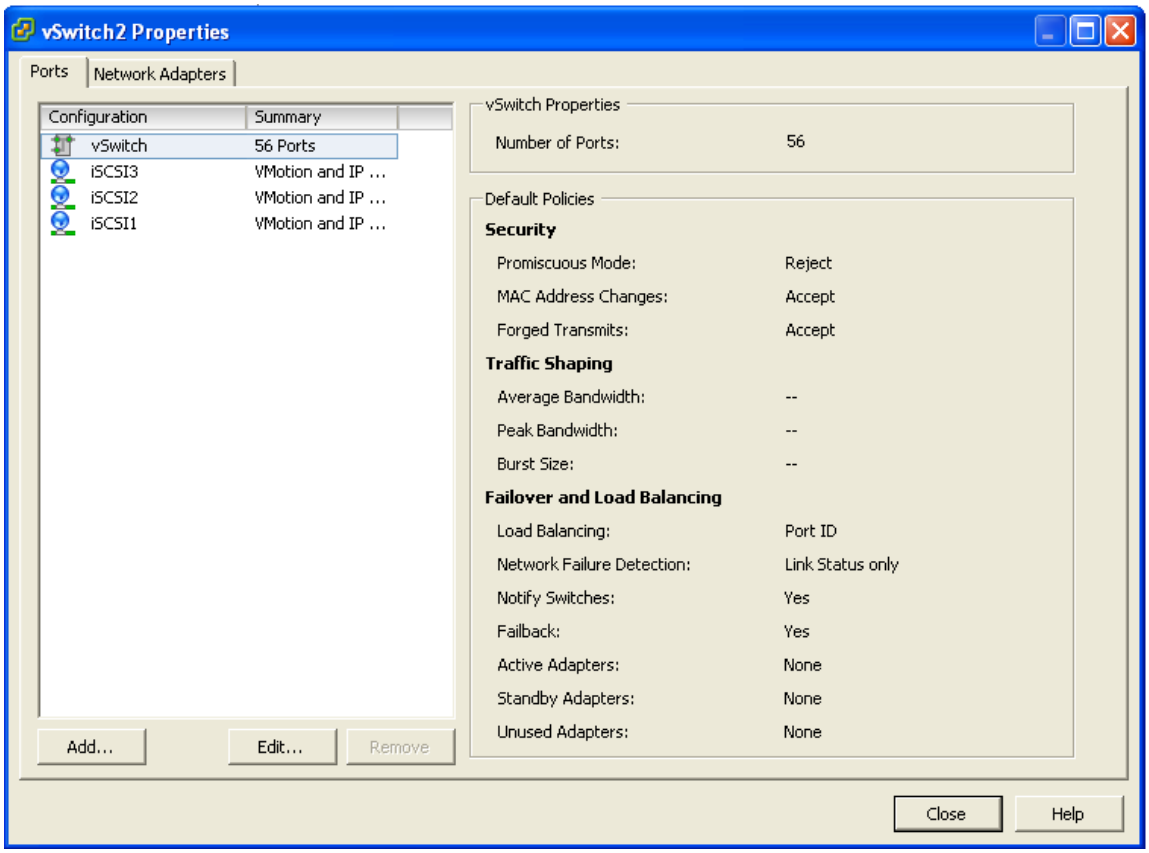
Switch Name	Num Ports	Used Ports	Configured Ports	MTU	Uplinks
vSwitch2	64	9	64	9000	

PortGroup Name	VLAN ID	Used Ports	Uplinks
iSCSI3	0	1	vmnic1,vmnic2,vmnic3
iSCSI2	0	1	vmnic1,vmnic2,vmnic3
iSCSI1	0	1	vmnic1,vmnic2,vmnic3

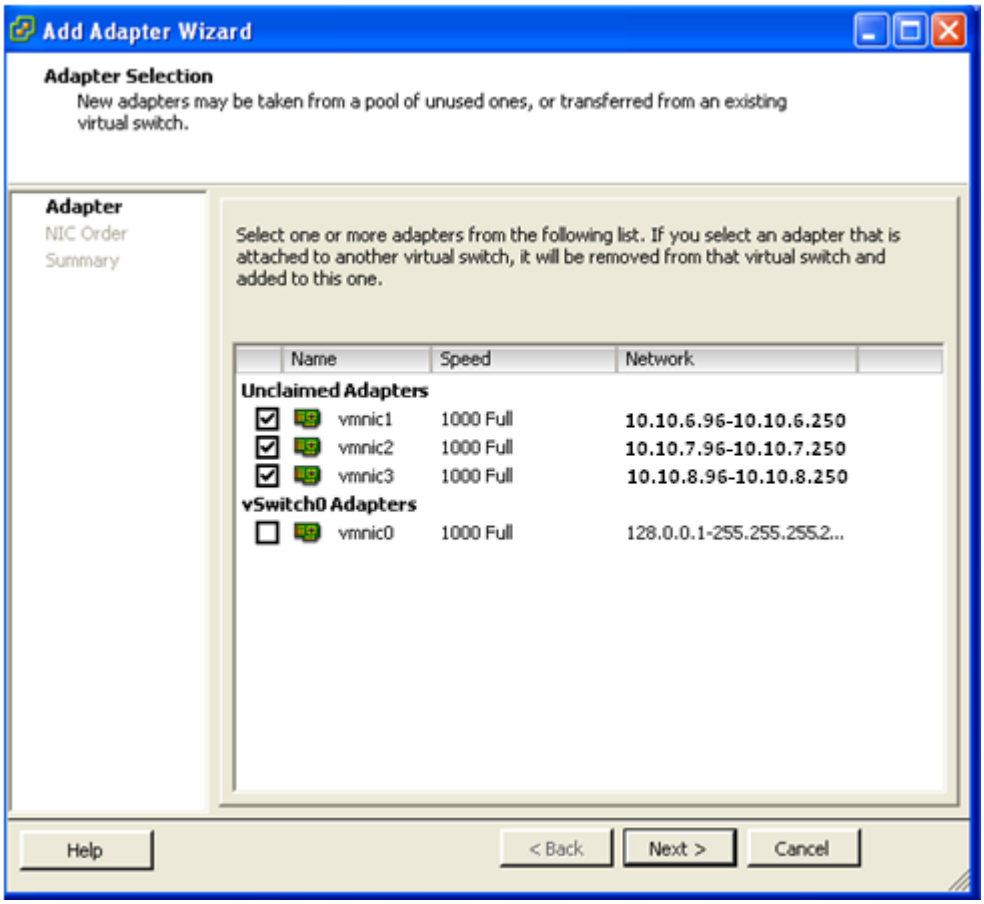
Adding a NIC can also be configured and verified in the vCenter GUI. Remember that the polling of vCenter is not instant so a refresh might need to occur to see the latest changes.

To configure this same process from the GUI, first navigate to the Networking section on the ESX host you are configuring. ***Configuration -> Networking***.

From here, click ***Properties*** on the vSwitch2.



Click the ***Network Adapters*** tab. Then click ***Add***. This will open up the Add Adapter Wizard. From here select the vmnics that you want to add to the vSwitch. In our example it will be vmnic1, vmnic2 and vmnic3.


Add Adapter Wizard
Adapter Selection
New adapters may be taken from a pool of unused ones, or transferred from an existing virtual switch.
Adapter
NIC Order
Summary
Select one or more adapters from the following list. If you select an adapter that is attached to another virtual switch, it will be removed from that virtual switch and added to this one.
Name
Speed
Network
Unclaimed Adapters
vmnic1 1000 Full 10.10.6.96-10.10.6.250
vmnic2 1000 Full 10.10.7.96-10.10.7.250
vmnic3 1000 Full 10.10.8.96-10.10.8.250
vSwitch0 Adapters
vmnic0 1000 Full 128.0.0.1-255.255.255.2...
Help
< Back
Next >
Cancel

Click ***Next*** after you have selected the chosen adapters. For now keep the defaults listed in the Failover Order screen and click ***Next***. Review the adapters listed and click ***Finish*** completing the process.

These adapters will now show up in the GUI under the Network Adapters tab.

STEP4: ASSOCIATE VMKERNEL PORTS TO PHYSICAL ADAPTERS

The next step is used to create the individual path bindings for each VMkernel to a NIC. This is required in order to take advantage of features such as Most Recently Used(MRU) and Round Robin(RR) multipathing policies or 3rd party MPIO plug-ins currently available from Dell.

From our previous step there are 3 VMkernel ports and 3 NICs. This means that each NIC will have 1 VMkernel ports assigned to it. Again, each environment will differ and these numbers can change based on the number of NICs and the number of paths assigned.

This process can be done either via vCLI or through the vCenter GUI.

By default, all the vmnics are assigned to each VMkernel port. We need to remove all but one vmnic from each VMkernel port so that each VMkernel port has only one uplink.

Before running these commands the switch information looks like the following (obtained using *esxcfg-vswitch –l* again):

Switch Name	Num Ports	Used Ports	Configured Ports	MTU	Uplinks
vSwitch2	64	7	64	9000	

PortGroup Name	VLAN ID	Used Ports	Uplinks
iSCSI3	0	1	vmnic1,vmnic2,vmnic3
iSCSI2	0	1	vmnic1,vmnic2,vmnic3
iSCSI1	0	1	vmnic1,vmnic2,vmnic3

You can see that there are three vmnics in each uplink for each VMkernel Port. This is what we need to change so that only a single vmnic is in each uplink and that we manually load balance them across all available VMkernel Ports.

To configure this process via vCLI first note the vmnic number of a NIC you want to remove and type the following command:

esxcfg-vswitch –p iSCSI1 –N vmnic3 vSwitch2

What this will do is remove vmnic3 from VMkernel port iSCSI1 so that now vmnic1 and vmnic2 are left on iSCSI1. We then need to remove vmnic2 so that only vmnic1 is associated with the iSCSI1. To do this type the following command:

esxcfg-vswitch –p iSCSI1 –N vmnic2 vSwitch2

Now that we have just one vmnic associated with one VMkernel port we need to remove the excess NICs on the other ports.

esxcfg-vswitch –p iSCSI2 –N vmnic1 vSwitch2

esxcfg-vswitch –p iSCSI2 –N vmnic3 vSwitch2

esxcfg-vswitch –p iSCSI3 –N vmnic1 vSwitch2

esxcfg-vswitch –p iSCSI3 –N vmnic2 vSwitch2

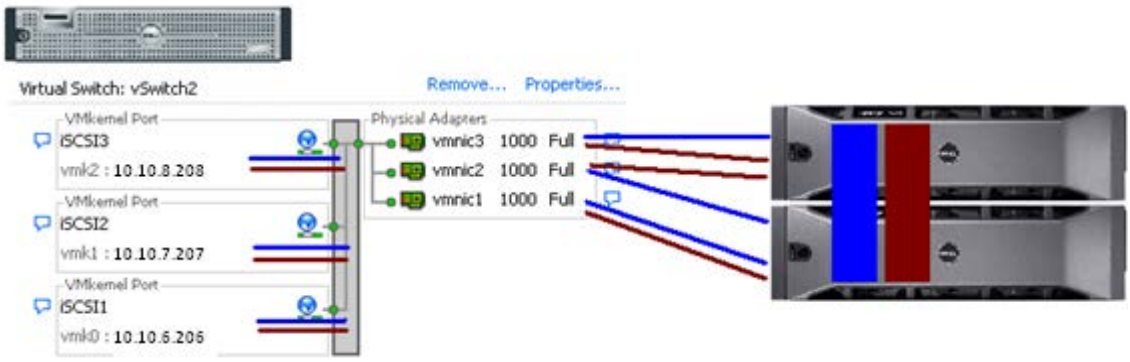
To verify that this was done correctly type the following command:

esxcfg-vswitch –l

The output will look similar to this:

Switch Name	Num Ports	Used Ports	Configured Ports	MTU	Uplinks
vSwitch2	64	7	64	9000	

PortGroup Name	VLAN ID	Used Ports	Uplinks
iSCSI3	0	1	vmnic3
iSCSI2	0	1	vmnic2
iSCSI1	0	1	vmnic1



The important thing to note is that under the Uplinks section there is only one vmnic assigned to each iSCSI VMkernel port and that they are evenly distributed across them.

This can also be done through the vCenter GUI. To configure this from the GUI first navigate to the Networking section on the ESX host you are configuring. ***Configuration -> Networking***.

From here, click ***Properties*** on the vSwitch2.

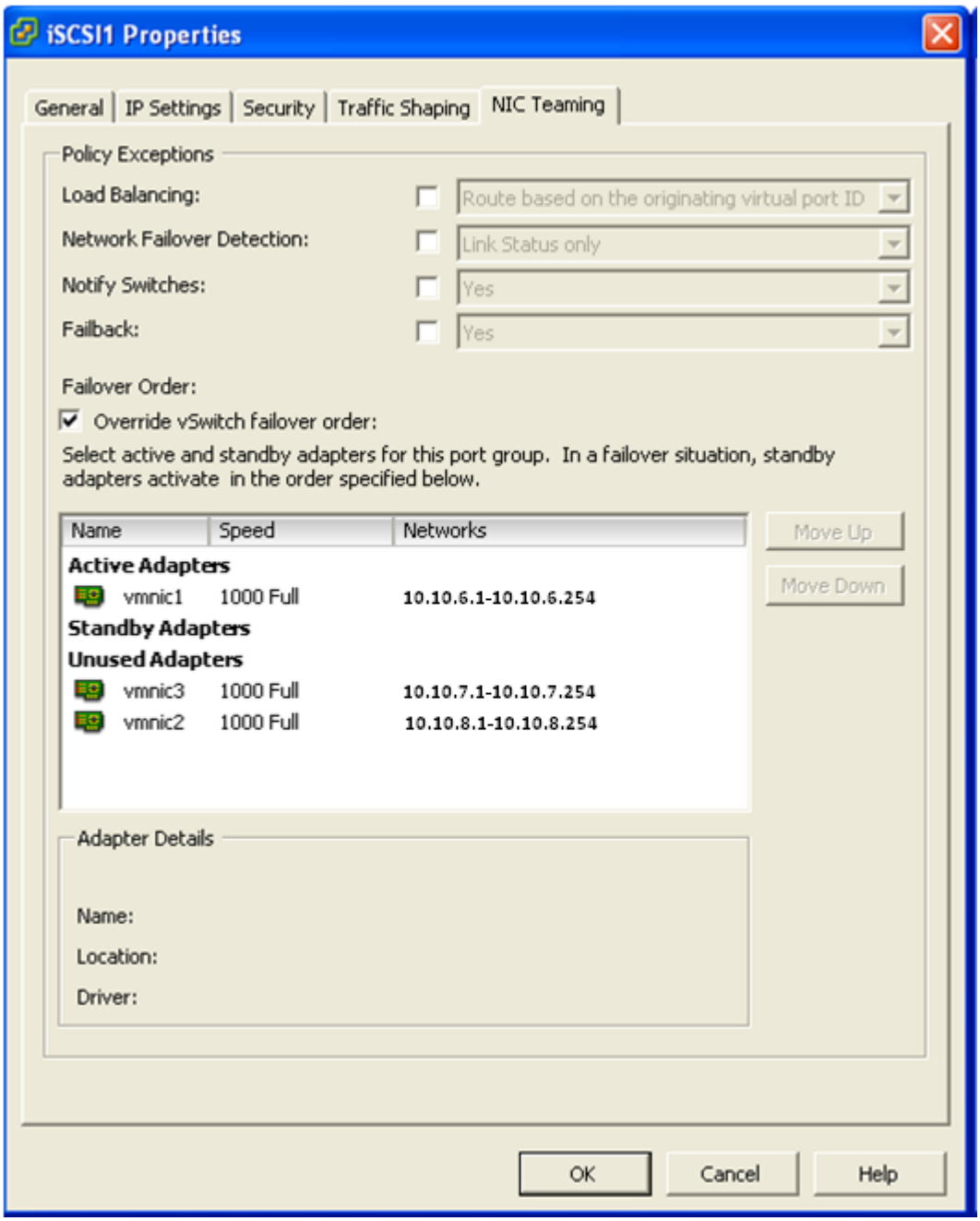
Select one of the VMkernel Ports, in this example iSCSI1 and click ***Edit***.

From here select the ***NIC Teaming*** tab.

Here you are going to select the check box for ***Override vSwitch failover order***.

Just like in the vCLI example we will assign vmnic1 to iSCSI1. This is done by selecting the adapters that are not going to be assigned to the VMkernel (vmnic2 and vmnic3 in this case) and clicking the ***Move Down*** button until it is listed under Unused Adapters. The following figure shows the completed result. Click ***Ok*** to complete the process. Do this

same thing for each of the iSCSI VMkernel ports so that each VMkernel port is mapped to only one adapter and they are all balanced. In this example we assigned iSCSI1to vmnic1, iSCSI2 to vmnic2 and iSCSI3 to vmnic3.



STEP5: ADD AN MD36XXI INTO THE ESX RULE SET

To use MD3600i with ESX 4.1 and ESX 4.1 Update 1, the MD36xxi PID has to be added to the manageable device list for VMW_SATP_LSI module. Otherwise, the guest host will not be able to see the mapped volumes and perform I/O's. The following command needs to be run from the command line on each ESX host before mapping virtual disks to ESX guest OS's. The setup of MD36xxi vs an MD32xxi is identical through Step4 of the procedure above.

At Step6 below, and prior to enabling the iSCSI initiator to prepare the ESX host to connect to the PowerVault SAN, on the ESX host you need to run

#/*example to add MD 3600i VID/PID (following the MD3200i format)*/

#esxcli nmp satp addrule -V DELL -M MD36xxi -s VMW_SATP_LSI

This command adds MD36xxi devices into the device list for VMW_SATP_LSI module.

Then proceed with Step6 and enable the iSCSI Software Initiator on ESX hosts.

STEP6: ENABLE VMWARE ISCSI SOFTWARE INITIATOR

This step enables the iSCSI initiator to prepare the ESX host to connect to the PowerVault SAN. This can be done either through a vCLI command or through the vCenter GUI.

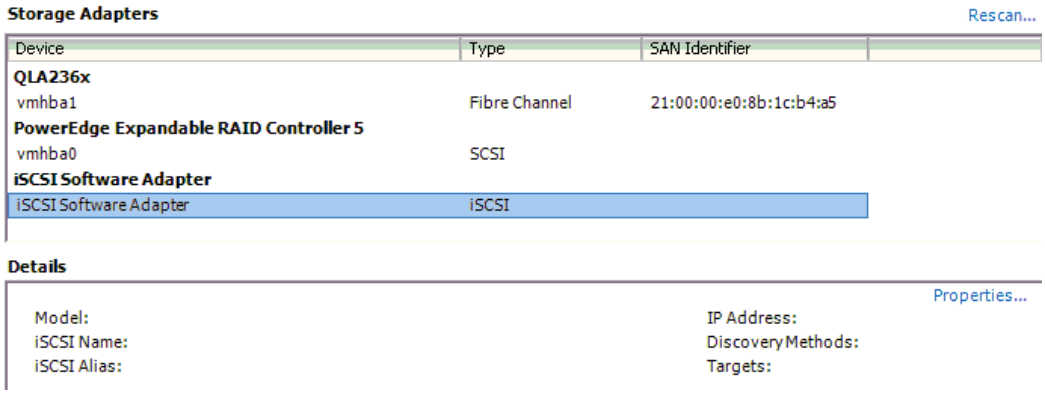
To enable the iSCSI initiator through the vCLI type the following command:
esxcfg-swiscsi –e

This will enable the software iSCSI initiator. To verify that it is enabled type the following command:

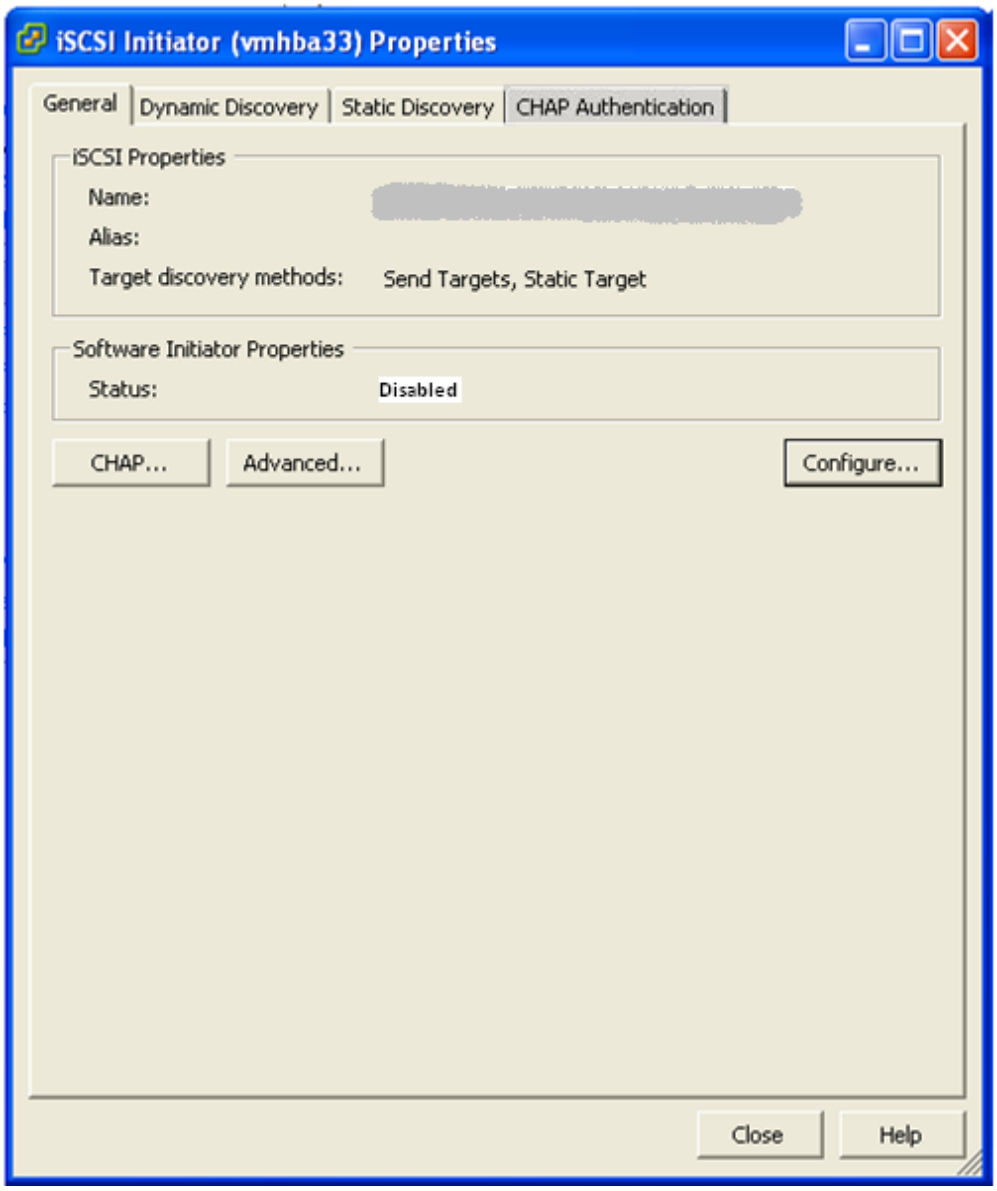
esxcfg-swiscsi –q

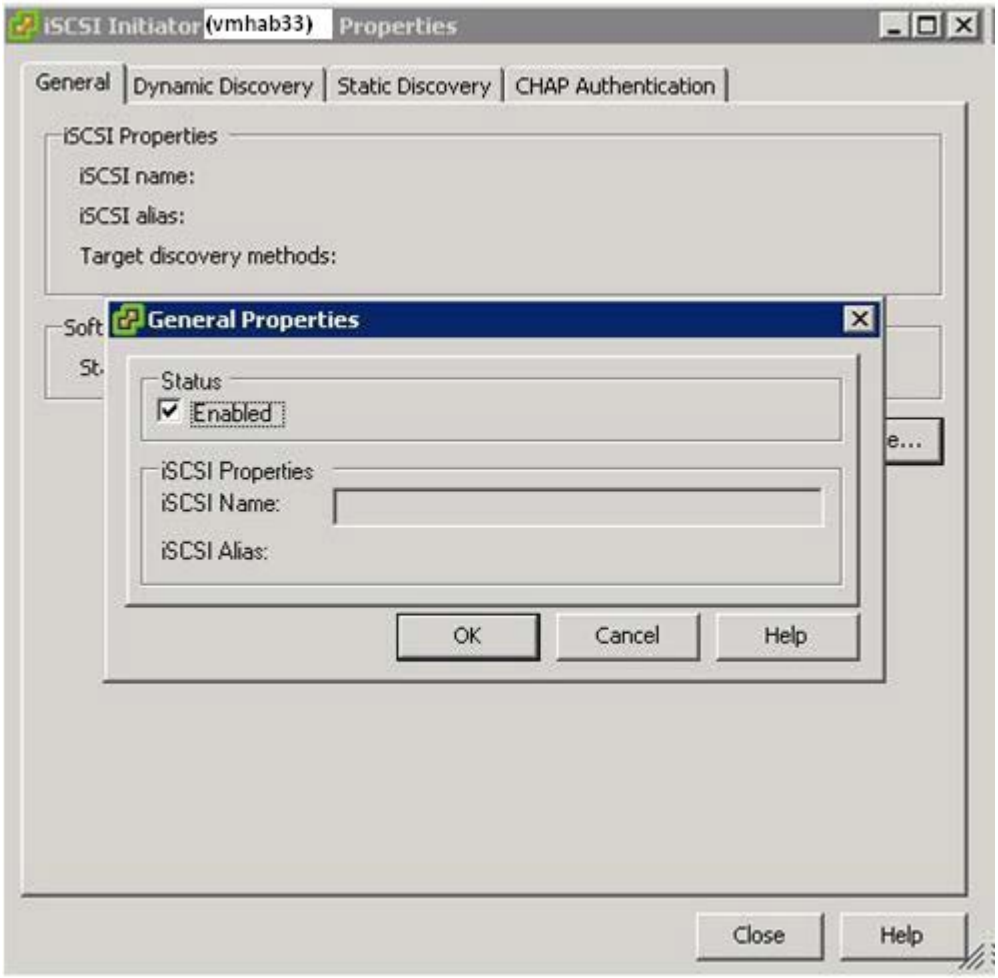
This can also be accomplished by using the vCenter GUI.

From the vCenter GUI on the ESX host navigate to ***Configuration -> Storage Adapters***. Select the iSCSI Software Adapter and click ***Properties***.



When the iSCSI properties window opens under the General tab click the ***Configure*** button. Place a check mark in ***Enabled*** and hit ***Ok***. This will enable the iSCSI initiator and assign a unique iqn to the ESX host. Administrators familiar with enabling iSCSI in ESX 3.5 will notice that the firewall policies are automatically set when you enable it in vSphere4.

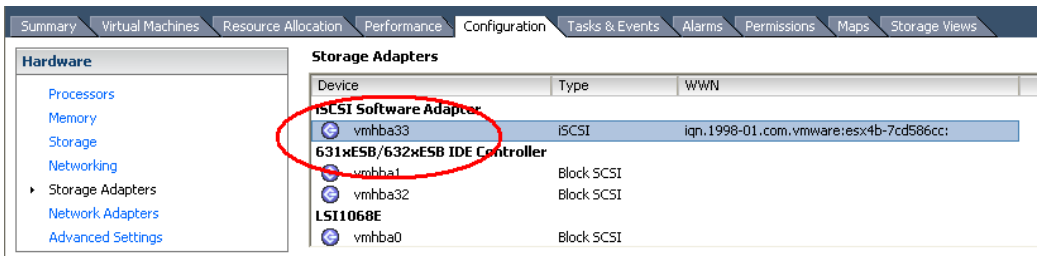

iSCSI Initiator (vmhba33) Properties
General
Dynamic Discovery
Static Discovery
CHAP Authentication
iSCSI Properties
Name:
Alias:
Target discovery methods:
Send Targets, Static Target
Software Initiator Properties
Status:
Disabled
CHAP...
Advanced...
Configure...
Close
Help



STEP7: BINDING VMKERNEL PORTS TO ISCSI SOFTWARE INITIATOR

This next step will bind the VMkernel ports, which were configured in Step 4 earlier, to the iSCSI Software Initiator. If this step is skipped there will only ever be a single connection to the PowerVault SAN. This step must be done via vCLI.

The first thing to do is to note the vmhba# of the iSCSI Software Initiator. This can be seen in the vCenter GUI on the ESX host under ***Configuration -> Storage Adapters***.



This can also be found by running the following vCLI command to discover all SCSI devices including the iSCSI software adapter:

esxcfg-scsidevs –a

The output will look something like the following:

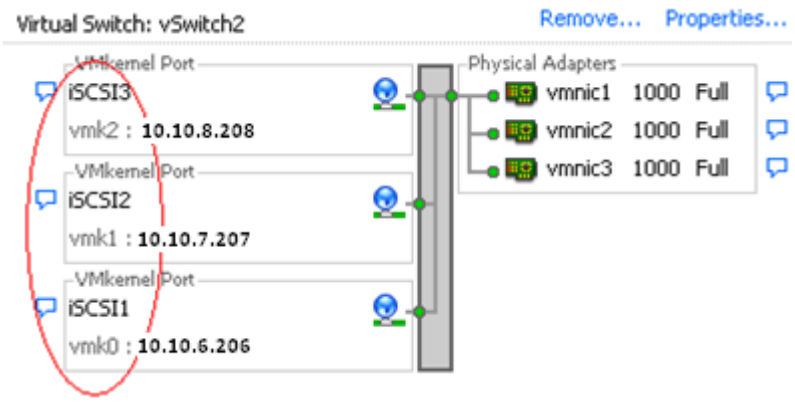
vmhba0 mptsas link-n/a sas.5001ec90e0ba7c00
(1:0.0) LSI Logic / Symbios Logic LSI1068E
vmhba1 ata_piix link-n/a ide.vmhba1
(0:31.1) Intel Corporation 631xESB/632xESB IDE Controller
vmhba32 ata_piix link-n/a ide.vmhba32
(0:31.1) Intel Corporation 631xESB/632xESB IDE Controller
vmhba33 iscsi_vmk link-n/a iscsi.vmhba33
() Software iSCSI

In this example from both the GUI and vCLI we can determine that the vmhba# for the iSCSI Software Initiator is vmhba33. This will be used in the next part. This will differ on various systems based on the devices installed.

The next piece of information to gather is the vmk# of each of the VMkernel ports. This can be done via the GUI or vCLI.

To determine the vmk# of each VMkernel port from the vCenter GUI navigate to ***Configuration -> Networking***. From the vSwitch that was created earlier under each VMkernel port, the vmk# will be listed.

NOTE: It is important to recognize that they may not start with vmk0, vMotion ports and other VMkernels will utilize the same numbers based on the order they are created.



In this example we see that iSCSI1 is vmk0, iSCSI2 is vmk1, and iSCSI3 is vmk2. This is also information that we need to note.

We can also see this in the vCLI by using the following command:

esxcfg-vmknic –l

The output will look similar to this:

Interface Port Group/DVPort IP Family IP Address
Netmask Broadcast MAC Address MTU TSO MSS
Enabled Type
vmk0 iSCSI1 IPv4 10.10.6.206
255.255.255.0 10.10.5.255 00:50:56:7b:d8:3e 9000 65535 true
STATIC
vmk1 iSCSI2 IPv4 10.10.7.207
255.255.255.0 10.10.5.255 00:50:56:7e:ae:80 9000 65535 true
STATIC
vmk2 iSCSI3 IPv4 10.10.8.208
255.255.255.0 10.10.5.255 00:50:56:74:a4:e0 9000 65535 true
STATIC

We can determine this same information from the GUI.

Now that we know the vmhba# and the vmk# we can map each VMkernel Port to the iSCSI Software Initiator. This is done through the vCLI by typing the following command:

esxcli swiscsi nic add –n vmk0 –d vmhba33

This will bind the vmk0 VMkernel port to the iSCSI Software Adapter vmhba33. We then proceed to bind all of the other vmk# to the same vmhba.

esxcli swiscsi nic add –n vmk1 –d vmhba33

esxcli swiscsi nic add –n vmk2 –d vmhba33

To verify that all of the vmk# are bound properly to the vmhba run the following command:

esxcli swiscsi nic list –d vmhba33

This will list all of the information for VMkernel ports that are assigned to the iSCSI Software Adapter.

STEP8: CONNECT TO POWERVAULT MD32XXI STORAGE

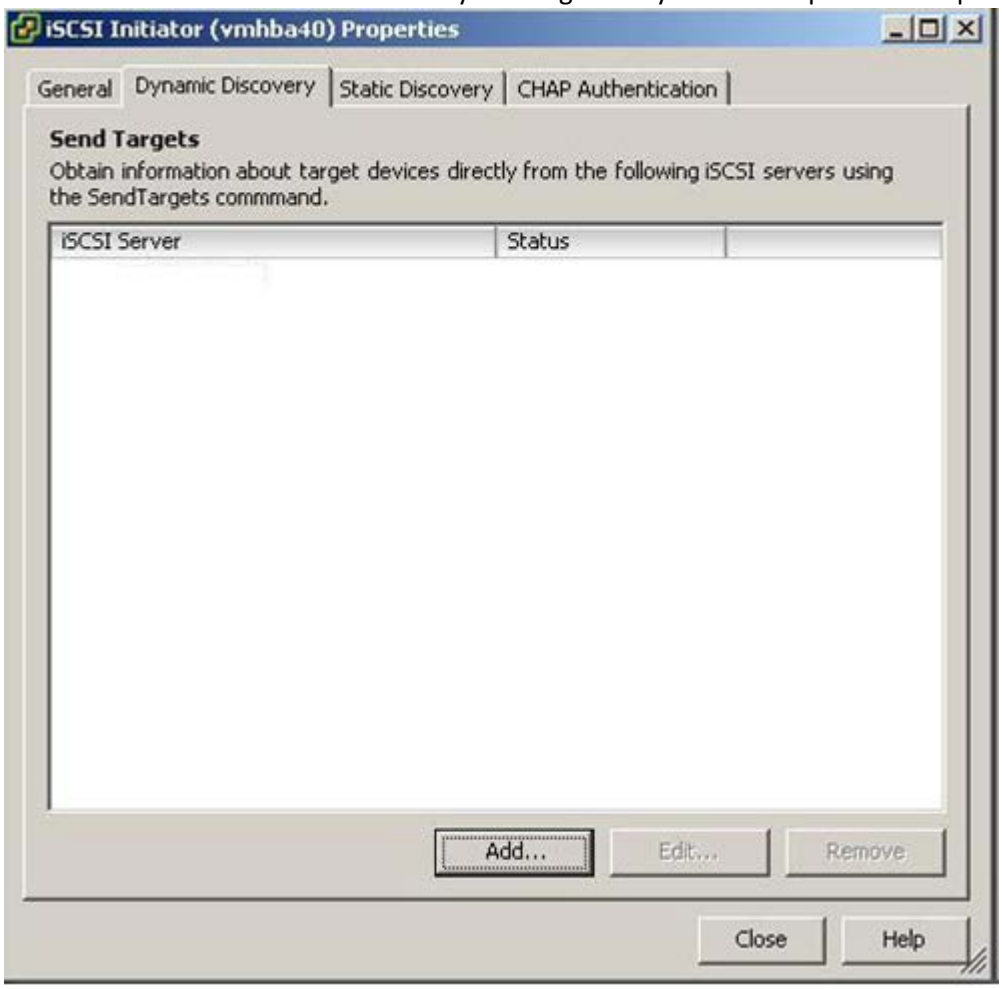
Now that the advanced configuration for the vSphere4 iSCSI Software Initiator has been completed, the next stage is to connect to the Dell PowerVault SAN.

More information for complete administration of the Dell PowerVault SAN can be found in the PowerVault User's Guide. In this example we will attach the iSCSI Software Initiator to the SAN. We will skip configuring CHAP but both one way and bi-directional CHAP is supported by the PowerVault SAN.

Navigate in the vCenter GUI to ***Configuration -> Storage Adapters***.
You should now see your iSCSI Target name listed.

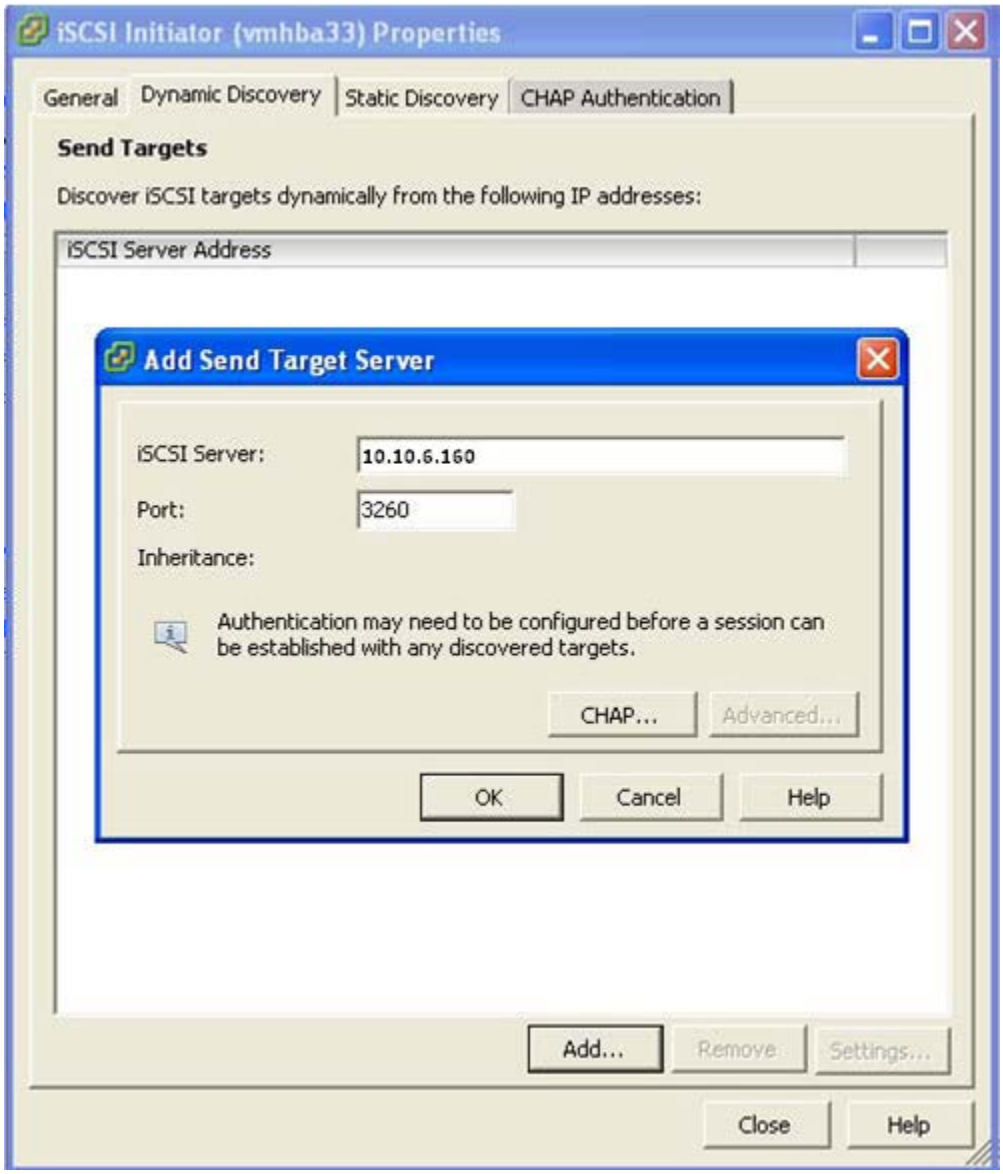
Click on the iSCSI Software Adapter and click ***Properties***.

In the iSCSI Server box type an IP Address for one of the iSCSI host ports of the PowerVault SAN and hit ***Ok***. There may be a slight delay before the process completes.



Click the ***Dynamic Discovery*** tab.

Click ***Add***.



When this is done click ***Close*** or enter in another IP Address if there are multiple SANs in your environment.

You will be prompted for a Rescan of the HBAs but at this time as there are no virtual disks assigned it is unnecessary.

The next step will be to create a new volume and assign it to the ESX server. This can be done multiple ways so refer to the PowerVault User's Guide for more information. In this example we will create a 100GB virtual disk and assign it to this ESX host using the iqn name.

STEP9: POWERVAULT MD32XXI STORAGE SETUP AND CONFIGURATION

Create virtual disks on MD32xxi using steps described in:

http://support.dell.com/support/edocs/systems/md3200i/multlang/GSG/DAO_BCC/GSG.pdf

Note: in this example the Storage array is an MD32xxi with virtual disks already configured using the *Configure Storage* Array selection under the Setup Tab. The new ESX host being added is named "VMware_host1".

After opening the Modular Disk Storage Manager and selecting the MD32xxi storage array to be configured, select the *Mappings* tab.

Manually Define Hosts *by* highlighting the Storage Array Name and right clicking. Select Define -> Host.

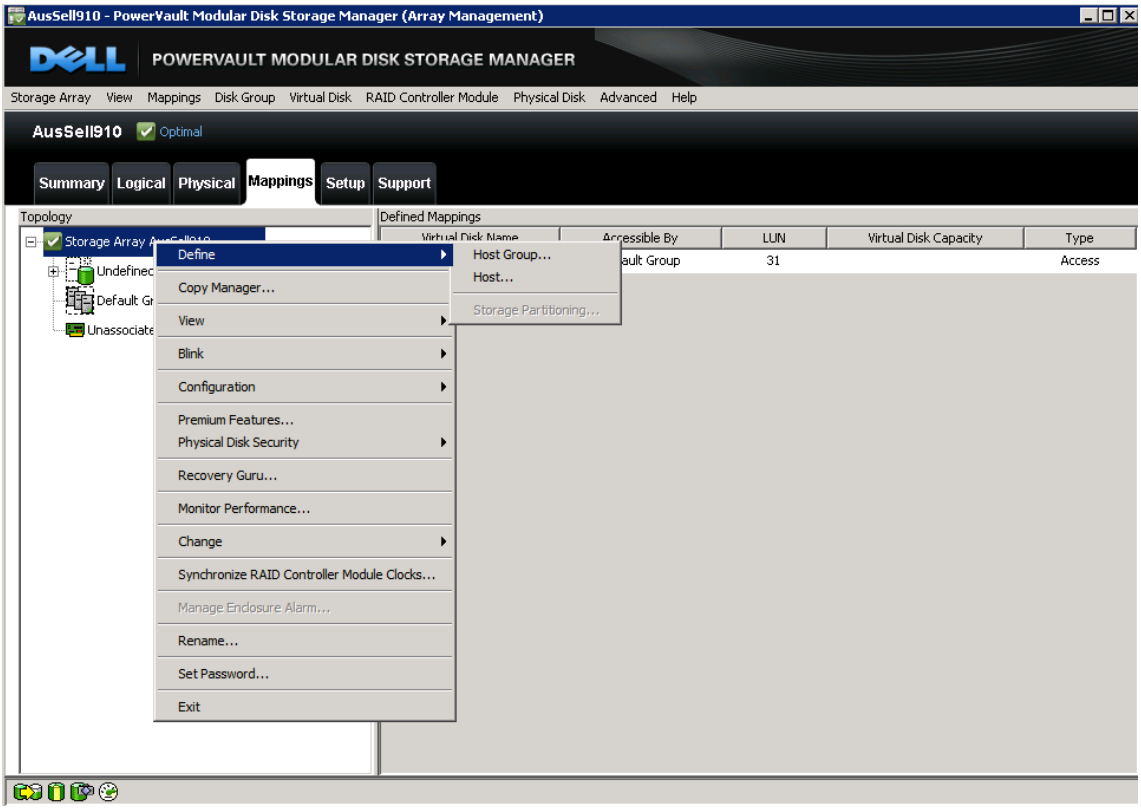


Figure 1 Defining the Storage Array Host Topology

Naming the host

Select a name that matches the naming convention used for the environment that you are configuring, for example, VMware_host1. Leave partitions enabled and select Next.

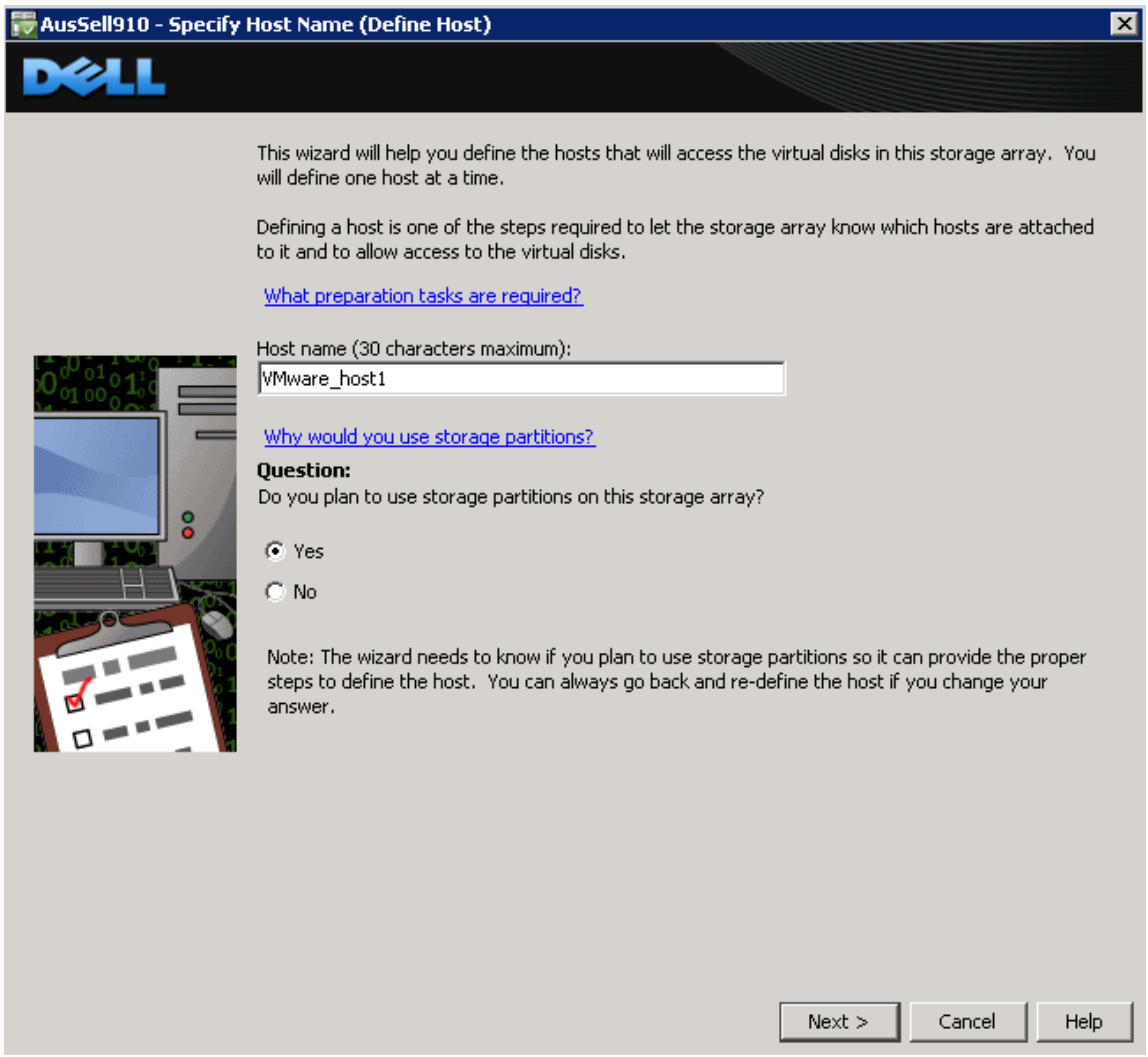

AusSell910 - Specify Host Name (Define Host)
This wizard will help you define the hosts that will access the virtual disks in this storage array. You will define one host at a time.
Defining a host is one of the steps required to let the storage array know which hosts are attached to it and to allow access to the virtual disks.
What preparation tasks are required?
Host name (30 characters maximum):
VMware_host1
Why would you use storage partitions?
Question:
Do you plan to use storage partitions on this storage array?
Yes
No
Note: The wizard needs to know if you plan to use storage partitions so it can provide the proper steps to define the host. You can always go back and re-define the host if you change your answer.
Next >
Cancel
Help

Figure 2 Naming the Host

Selecting host port identifiers

Using the pull down select the host port identifier. In this example because the iSCSI session has already been established the iqn is already in the list.

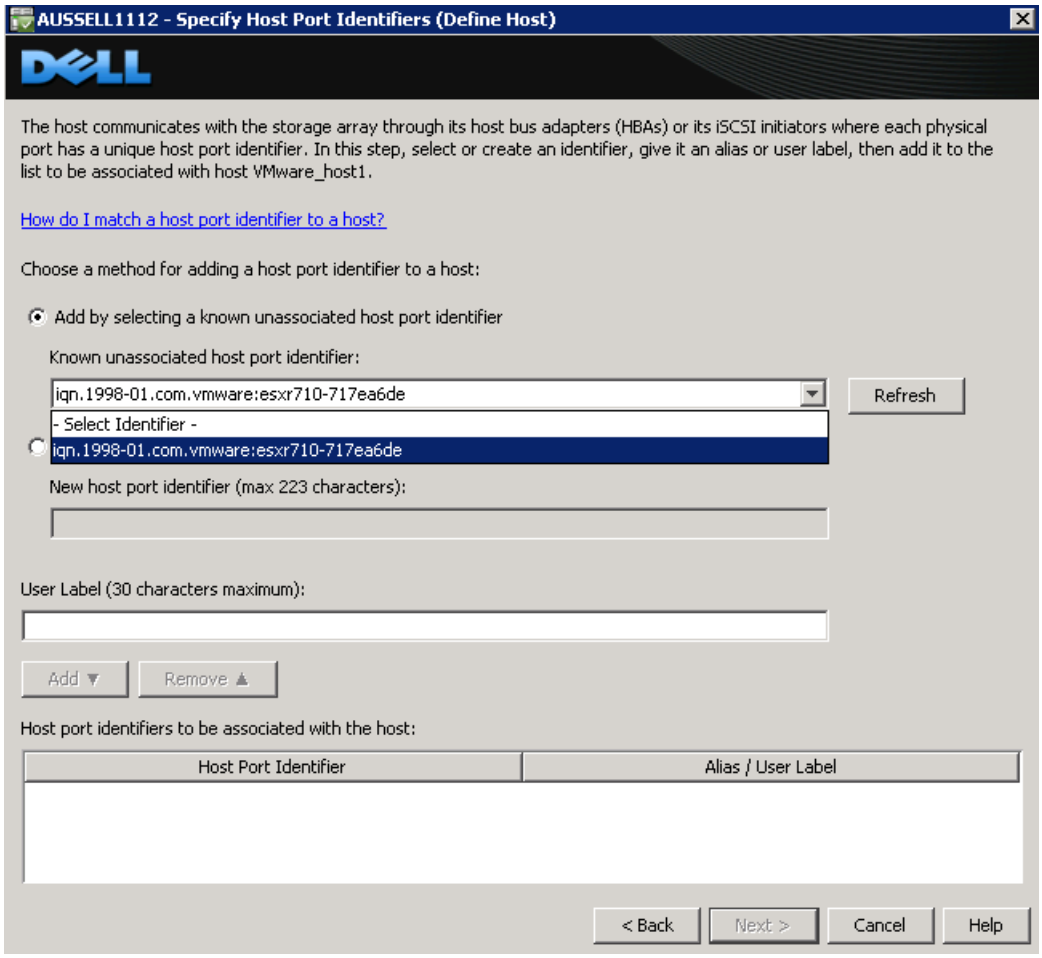
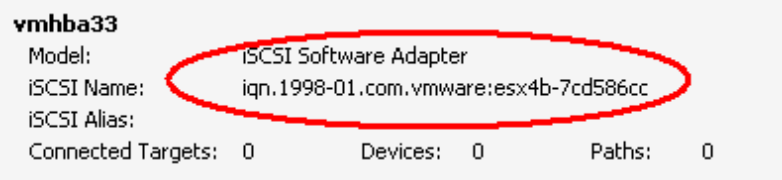

AUSSELL1112 - Specify Host Port Identifiers (Define Host)
The host communicates with the storage array through its host bus adapters (HBAs) or its iSCSI initiators where each physical port has a unique host port identifier. In this step, select or create an identifier, give it an alias or user label, then add it to the list to be associated with host VMware_host1.
How do I match a host port identifier to a host?
Choose a method for adding a host port identifier to a host:
Add by selecting a known unassociated host port identifier
Known unassociated host port identifier:
iqn.1998-01.com.vmware:esxr710-717ea6de
Refresh
- Select Identifier -
iqn.1998-01.com.vmware:esxr710-717ea6de
New host port identifier (max 223 characters):
User Label (30 characters maximum):
Add
Remove
Host port identifiers to be associated with the host:
Host Port Identifier
Alias / User Label
< Back
Next >
Cancel
Help

Figure 3 Selecting Host Port Identifiers

Note: You can also add the iqn manually. To find the iSCSI Initiator Name from the vCenter GUI go to ***Configuration -> Storage Adapters***. Click on the iSCSI Software Adapter. The iqn can be copied and pasted into the add by creating a host port identifier field.



Entering host port alias

An alias is used in the topology tree to identify the port. Add a unique alias for this host port such as the one below, then select ***Add***

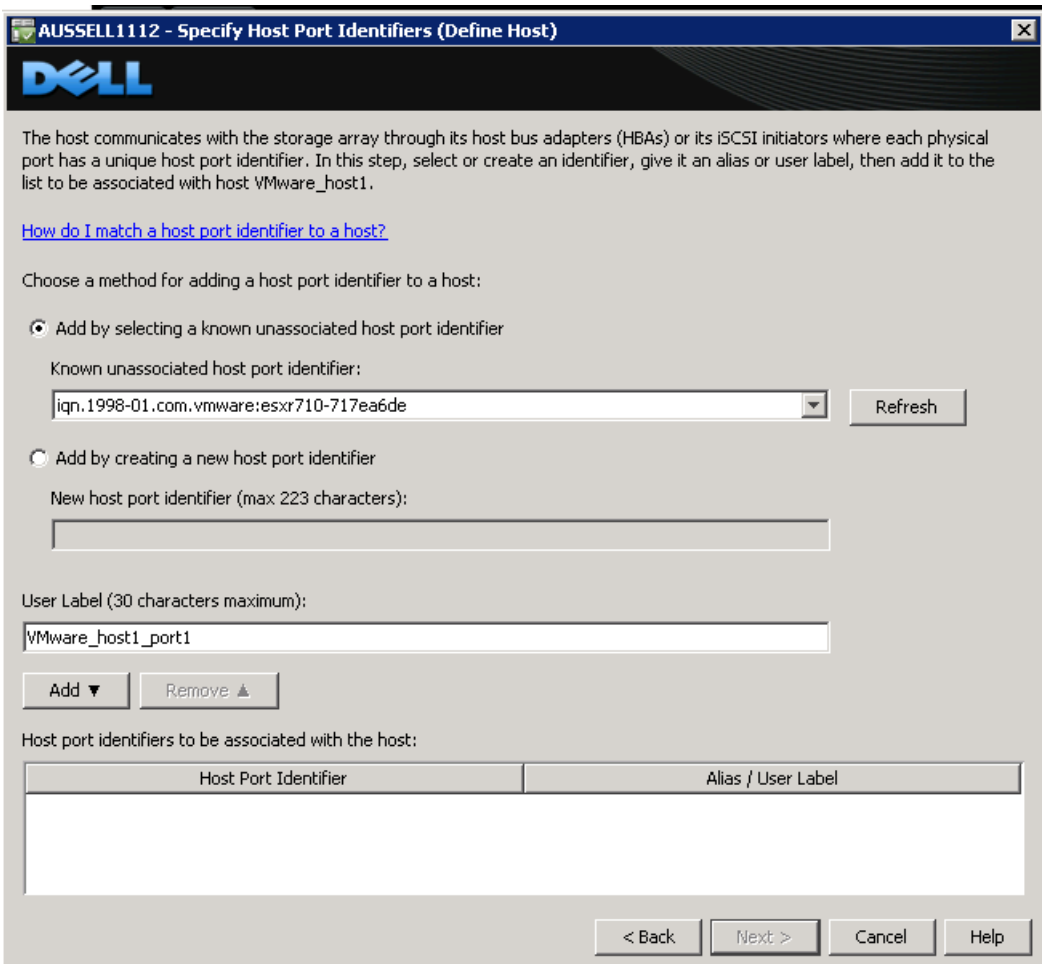

AUSSELL1112 - Specify Host Port Identifiers (Define Host)
The host communicates with the storage array through its host bus adapters (HBAs) or its iSCSI initiators where each physical port has a unique host port identifier. In this step, select or create an identifier, give it an alias or user label, then add it to the list to be associated with host VMware_host1.
How do I match a host port identifier to a host?
Choose a method for adding a host port identifier to a host:
Add by selecting a known unassociated host port identifier
Known unassociated host port identifier:
iqn.1998-01.com.vmware:esxr710-717ea6de
Refresh
Add by creating a new host port identifier
New host port identifier (max 223 characters):
User Label (30 characters maximum):
VMware_host1_port1
Add
Remove
Host port identifiers to be associated with the host:
Host Port Identifier
Alias / User Label
< Back
Next >
Cancel
Help

Figure 4 Adding Host Port Alias

The completed host port screen will be similar to the one below. Select ***Next*** to continue.

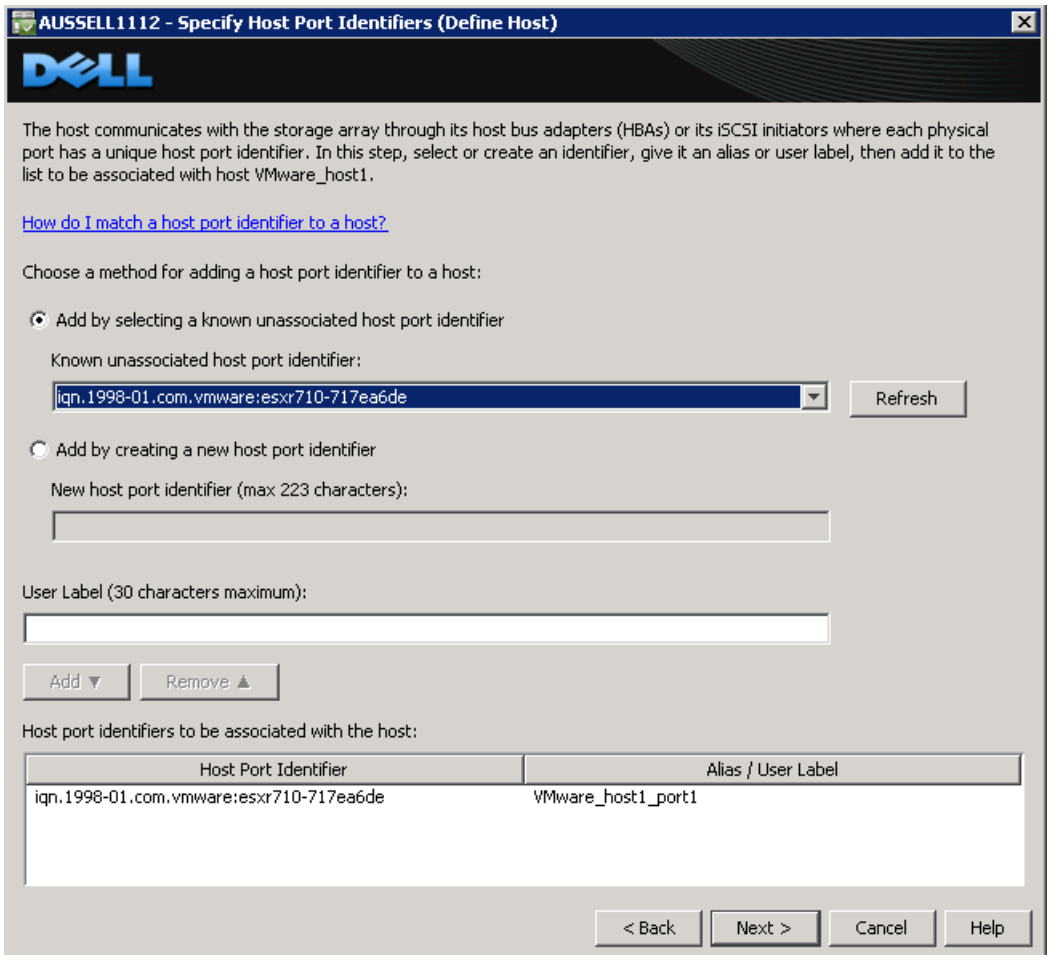

AUSSELL1112 - Specify Host Port Identifiers (Define Host)
The host communicates with the storage array through its host bus adapters (HBAs) or its iSCSI initiators where each physical port has a unique host port identifier. In this step, select or create an identifier, give it an alias or user label, then add it to the list to be associated with host VMware_host1.
How do I match a host port identifier to a host?
Choose a method for adding a host port identifier to a host:
Add by selecting a known unassociated host port identifier
Known unassociated host port identifier:
iqn.1998-01.com.vmware:esxr710-717ea6de
Refresh
Add by creating a new host port identifier
New host port identifier (max 223 characters):
User Label (30 characters maximum):
Add ▼
Remove ▲
Host port identifiers to be associated with the host:
Host Port Identifier
Alias / User Label
iqn.1998-01.com.vmware:esxr710-717ea6de
VMware_host1_port1
< Back
Next >
Cancel
Help

Figure 5 Completed Host Port Identifier

Select ***VMware*** as the host type

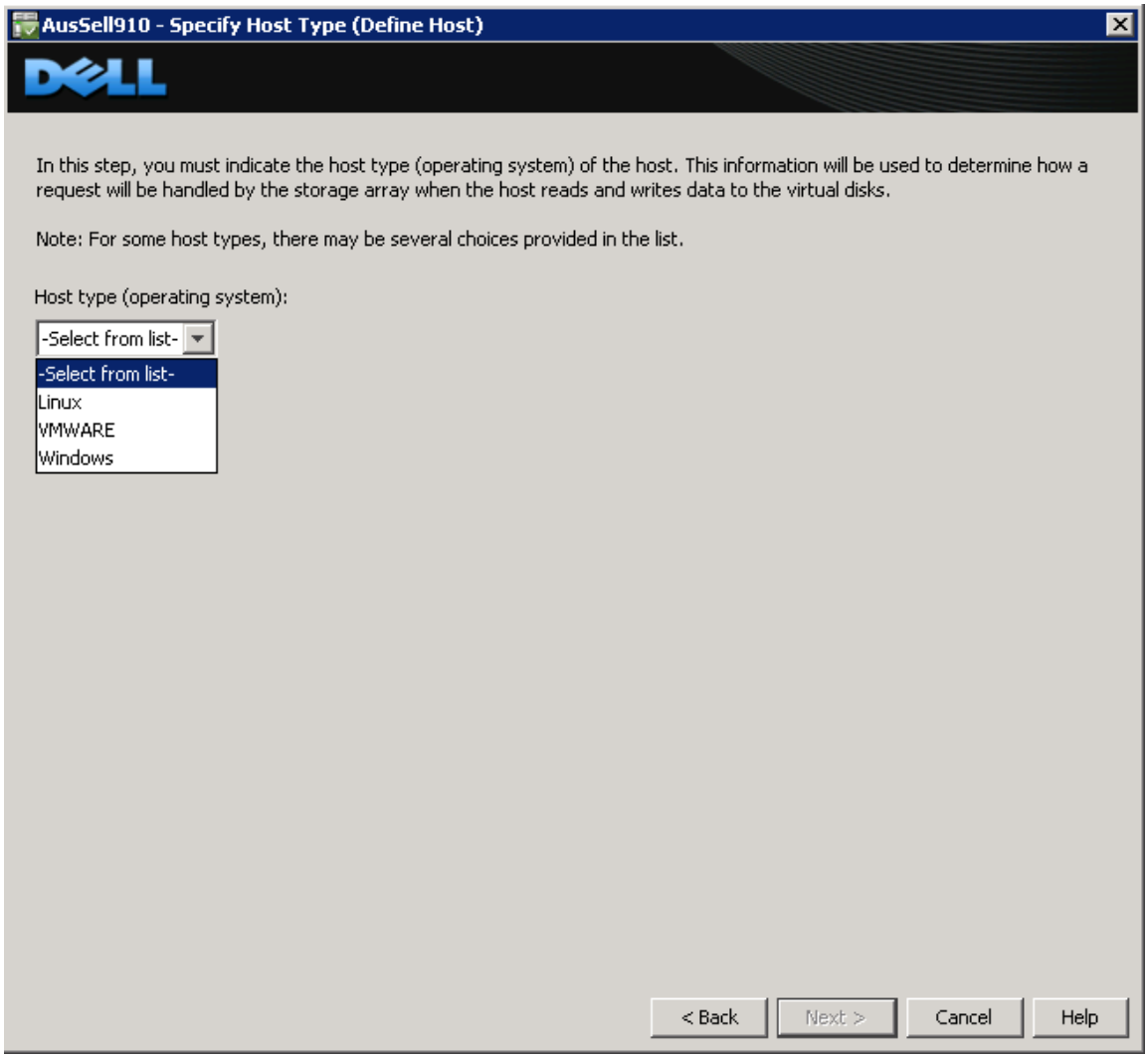

AusSell910 - Specify Host Type (Define Host)
In this step, you must indicate the host type (operating system) of the host. This information will be used to determine how a request will be handled by the storage array when the host reads and writes data to the virtual disks.
Note: For some host types, there may be several choices provided in the list.
Host type (operating system):
-Select from list-
-Select from list-
Linux
VMWARE
Windows
< Back
Next >
Cancel
Help

Figure 6 Selecting Host Type

If you intend to use advanced VMware features such as VMotion then this host will share access with other ESX servers and you will have to create a Host Group. We will create a host group for this example.

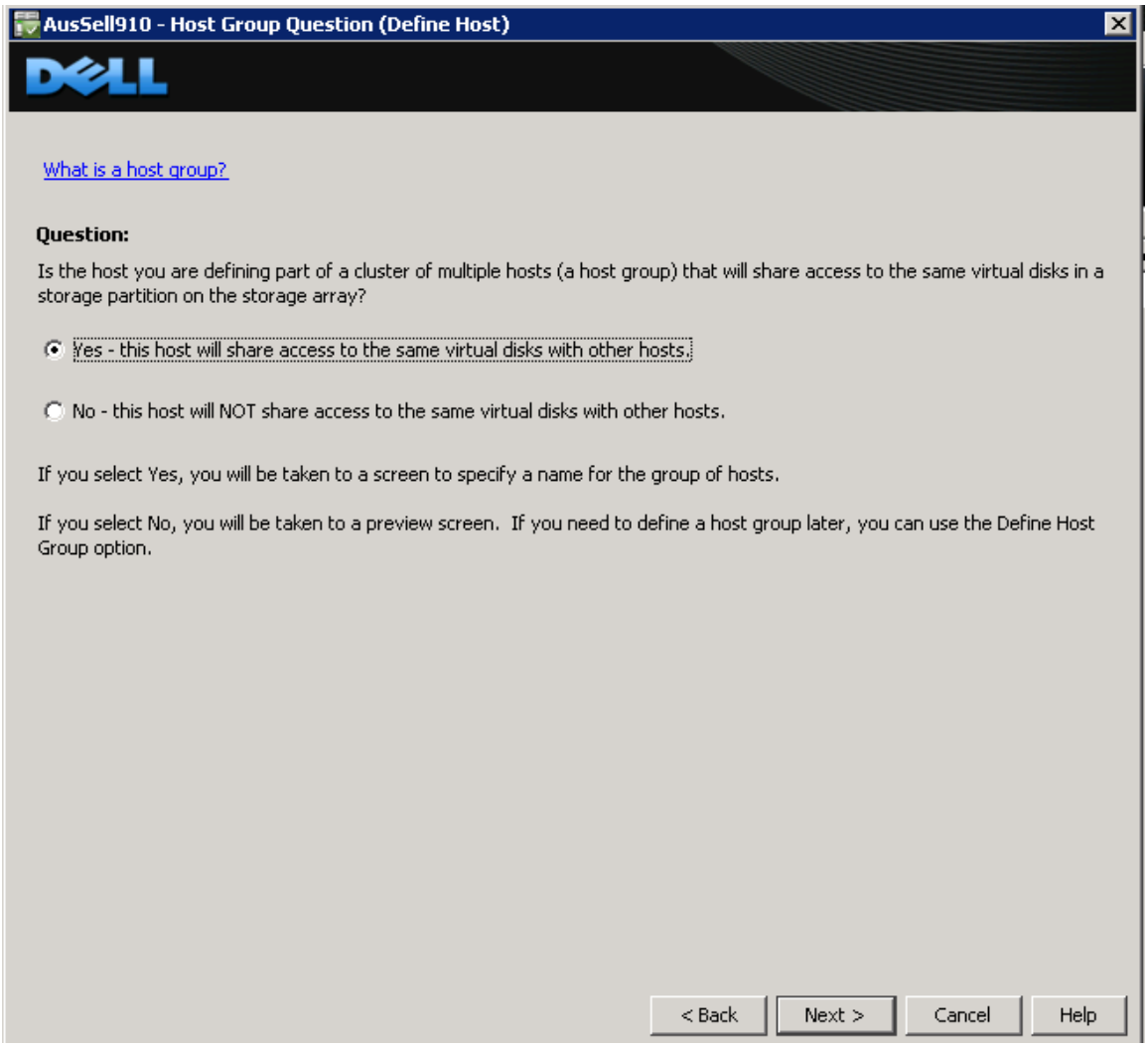

AusSell910 - Host Group Question (Define Host)
What is a host group?
Question:
Is the host you are defining part of a cluster of multiple hosts (a host group) that will share access to the same virtual disks in a storage partition on the storage array?
Yes - this host will share access to the same virtual disks with other hosts.
No - this host will NOT share access to the same virtual disks with other hosts.
If you select Yes, you will be taken to a screen to specify a name for the group of hosts.
If you select No, you will be taken to a preview screen. If you need to define a host group later, you can use the Define Host Group option.
< Back
Next >
Cancel
Help

Figure 7 Host Group Question

Host Group name

Enter a host group name that is appropriate for your environment. For this example we used VMware_Group1

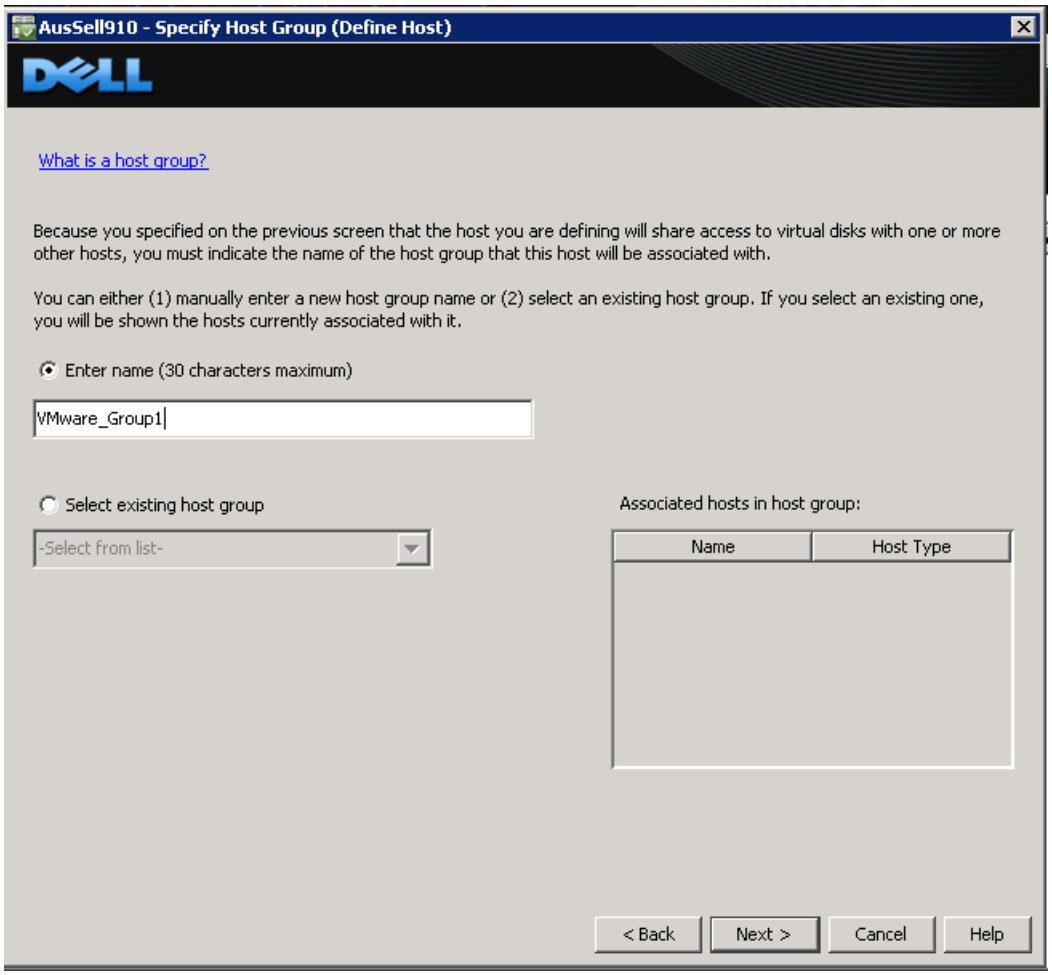

AusSell910 - Specify Host Group (Define Host)
What is a host group?
Because you specified on the previous screen that the host you are defining will share access to virtual disks with one or more other hosts, you must indicate the name of the host group that this host will be associated with.
You can either (1) manually enter a new host group name or (2) select an existing host group. If you select an existing one, you will be shown the hosts currently associated with it.
Enter name (30 characters maximum)
VMware_Group1
Select existing host group
-Select from list-
Associated hosts in host group:
Name
Host Type
< Back
Next >
Cancel
Help

Figure 8 Host Group Name

Preview Define host

If all of the information is correct for your environment select Finish.

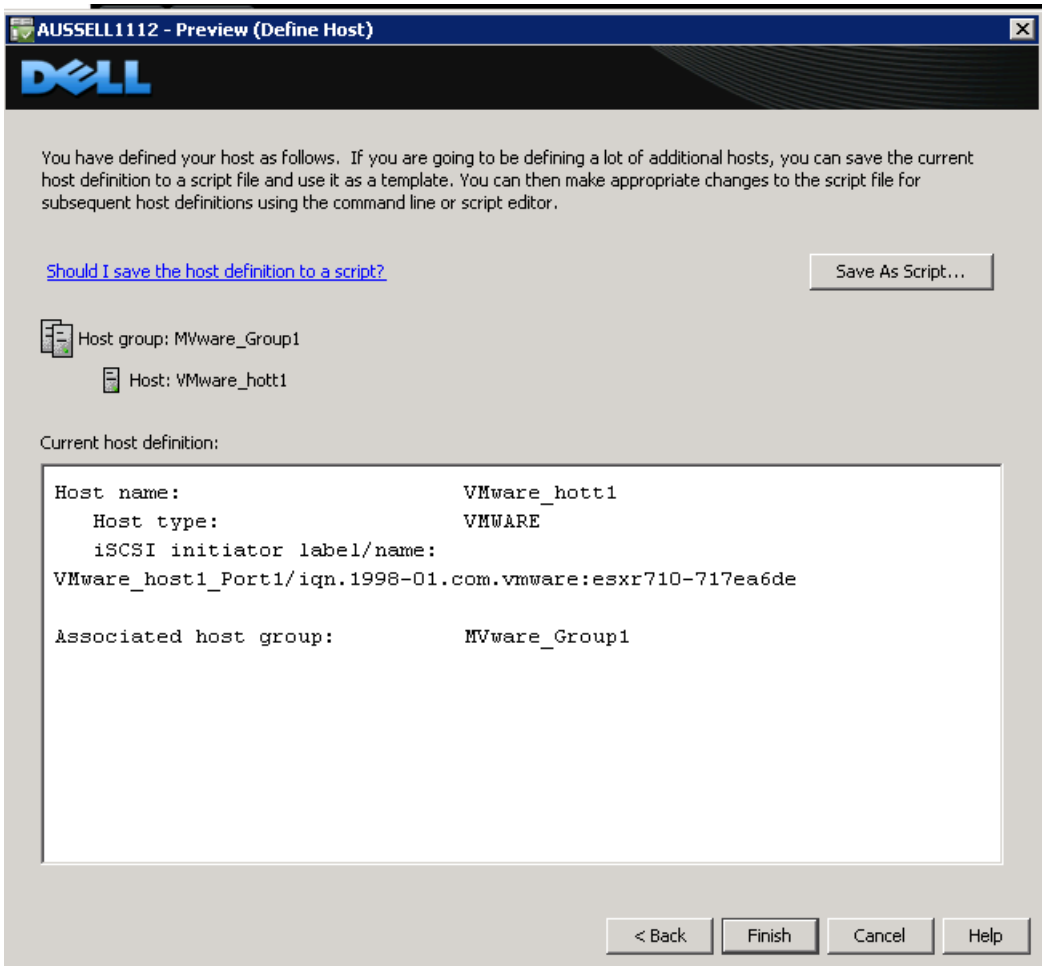

AUSSELL1112 - Preview (Define Host)
You have defined your host as follows. If you are going to be defining a lot of additional hosts, you can save the current host definition to a script file and use it as a template. You can then make appropriate changes to the script file for subsequent host definitions using the command line or script editor.
Should I save the host definition to a script?
Save As Script...
Host group: MVware_Group1
Host: VMware_hott1
Current host definition:
Host name: VMware_hott1
Host type: VMWARE
iSCSI initiator label/name:
VMware_host1_Port1/iqn.1998-01.com.vmware:esxr710-717ea6de
Associated host group: MVware_Group1
< Back
Finish
Cancel
Help

Figure 9 Preview (Define Host)

Creation successful

Select No at this time. You can add additional Hosts after you have finished configuring the current host.

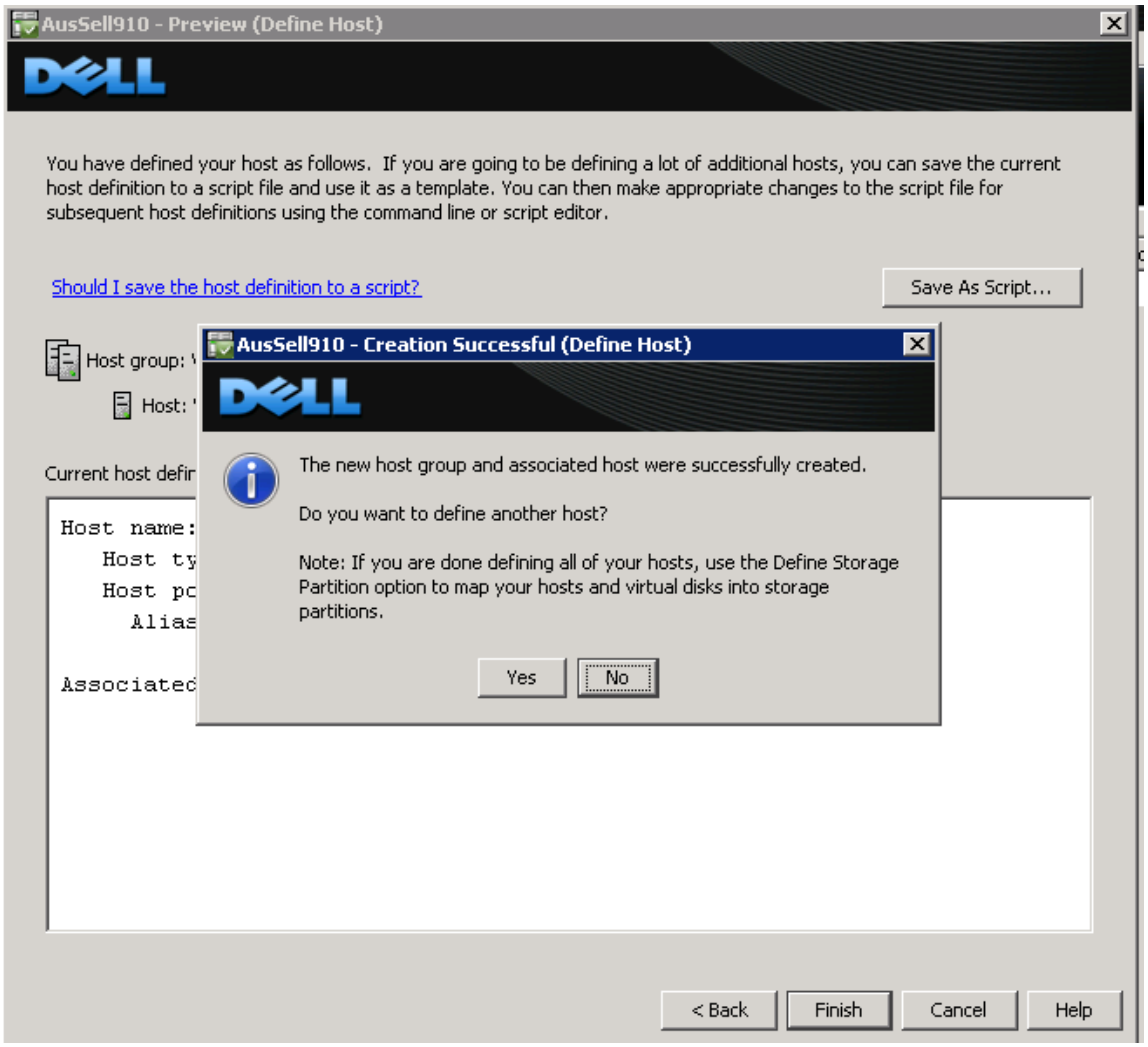

AusSell910 - Preview (Define Host)
You have defined your host as follows. If you are going to be defining a lot of additional hosts, you can save the current host definition to a script file and use it as a template. You can then make appropriate changes to the script file for subsequent host definitions using the command line or script editor.
Should I save the host definition to a script?
Save As Script...
Host group:
Host:
Current host defir
Host name:
Host ty
Host pc
Alias
Associated
AusSell910 - Creation Successful (Define Host)
The new host group and associated host were successfully created.
Do you want to define another host?
Note: If you are done defining all of your hosts, use the Define Storage Partition option to map your hosts and virtual disks into storage partitions.
Yes
No
< Back
Finish
Cancel
Help

Figure 10 Topology Creation Successful

Define Mappings for LUNs

Note: In this example the Disk Groups and Virtual Disks have already been created using the wizard under the Setup Tab.

In the topology tree expand the Undefined Mappings and highlight one of the Virtual Disks. Right Click and select *Define Additional Mappings*.

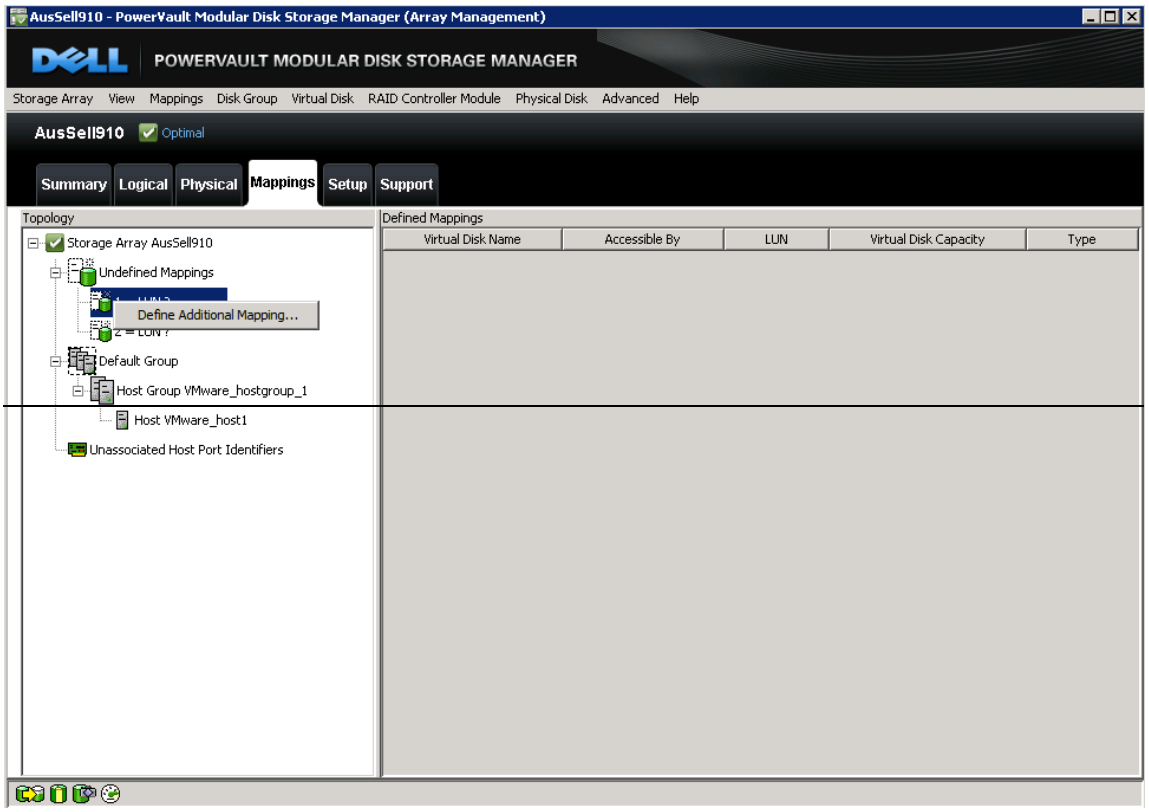


Figure 11 Selecting a Virtual Disk for mapping

Remember that the virtual disk is assigned to the host group and not the host. For this example we selected the host group that was defined in the previous steps.

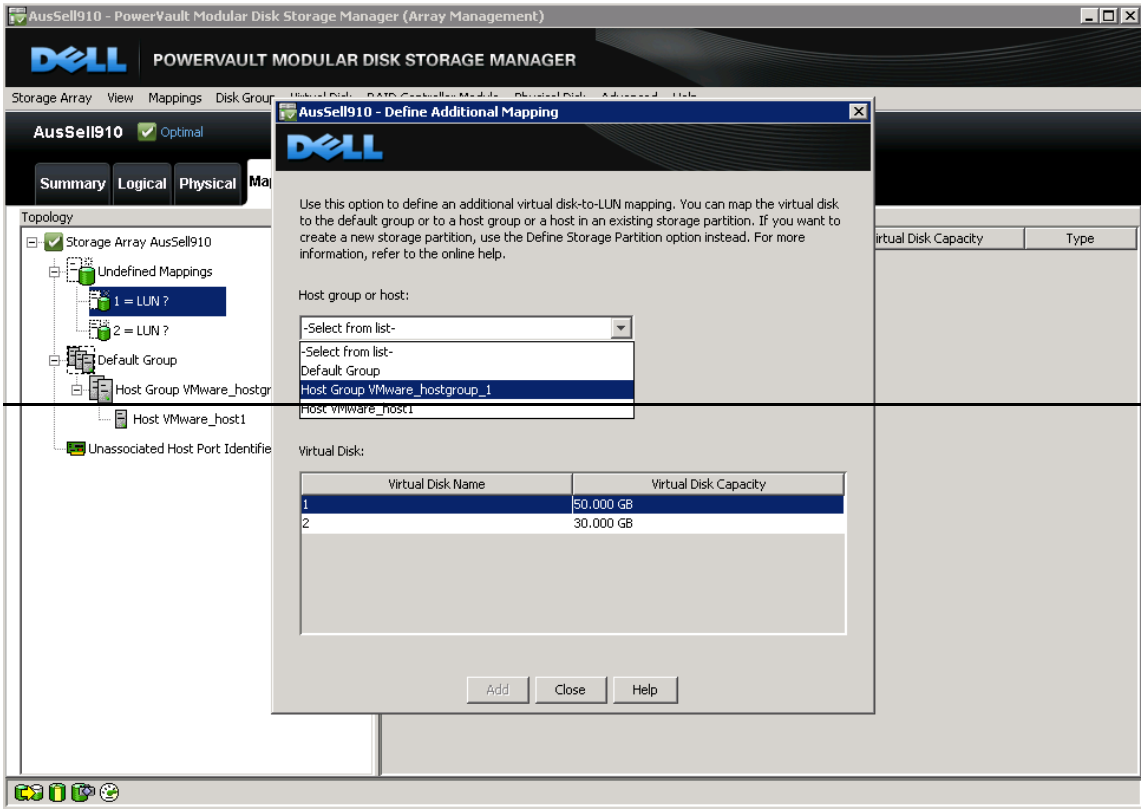

AusSell910 - PowerVault Modular Disk Storage Manager (Array Management)
POWERVAULT MODULAR DISK STORAGE MANAGER
Storage Array View Mappings Disk Group
AusSell910 Optimal
Summary Logical Physical
Topology
Storage Array AusSell910
Undefined Mappings
1 = LUN ?
2 = LUN ?
Default Group
Host Group VMware_hostgr
Host VMware_host1
Unassociated Host Port Identifie
AusSell910 - Define Additional Mapping
Use this option to define an additional virtual disk-to-LUN mapping. You can map the virtual disk to the default group or to a host group or a host in an existing storage partition. If you want to create a new storage partition, use the Define Storage Partition option instead. For more information, refer to the online help.
Host group or host:
-Select from list-
-Select from list-
Default Group
Host Group VMware_hostgroup_1
Host VMware_host1
Virtual Disk:
Virtual Disk Name
Virtual Disk Capacity
1
50.000 GB
2
30.000 GB
Add
Close
Help
irtual Disk Capacity
Type

Figure 12 Selecting the Host Group

Assign the other virtual disk to the same host group.

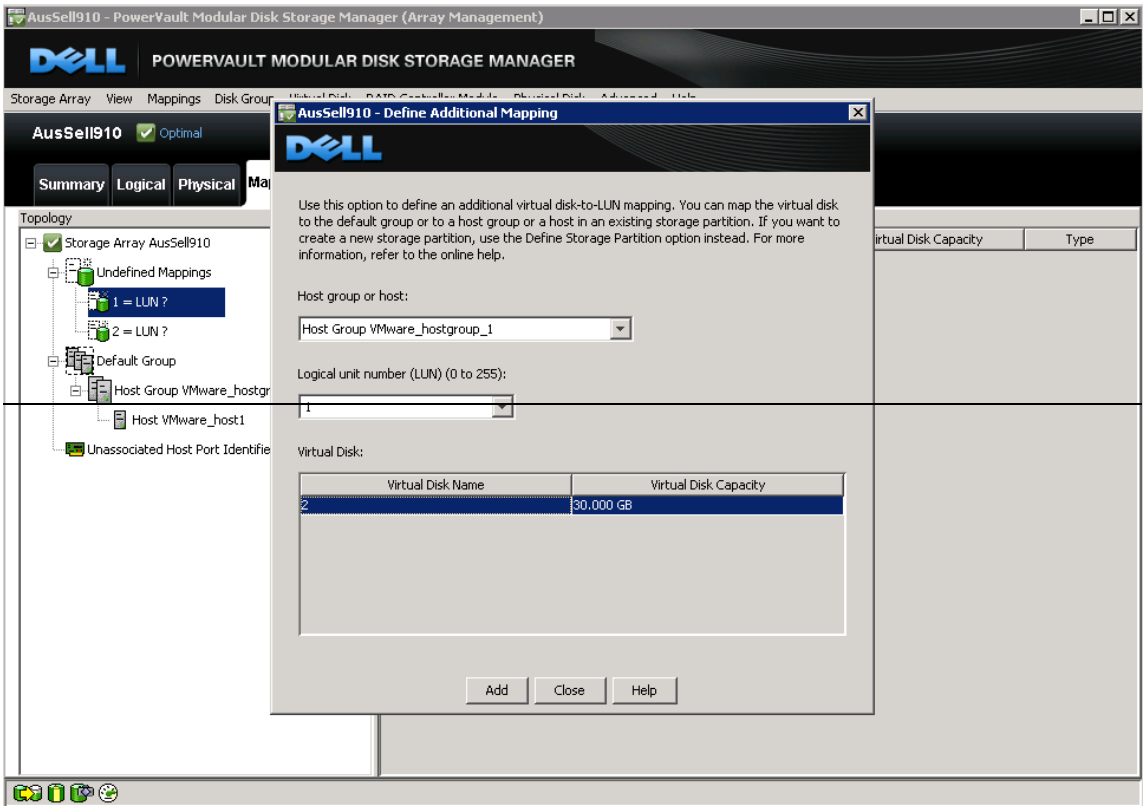

AusSell910 - PowerVault Modular Disk Storage Manager (Array Management)
POWERVAULT MODULAR DISK STORAGE MANAGER
Storage Array View Mappings Disk Group
AusSell910 Optimal
Summary Logical Physical
Topology
Storage Array AusSell910
Undefined Mappings
1 = LUN ?
2 = LUN ?
Default Group
Host Group VMware_hostgr
Host VMware_host1
Unassociated Host Port Identifie
irtual Disk Capacity
Type
AusSell910 - Define Additional Mapping
Use this option to define an additional virtual disk-to-LUN mapping. You can map the virtual disk to the default group or to a host group or a host in an existing storage partition. If you want to create a new storage partition, use the Define Storage Partition option instead. For more information, refer to the online help.
Host group or host:
Host Group VMware_hostgroup_1
Logical unit number (LUN) (0 to 255):
1
Virtual Disk:
Virtual Disk Name
Virtual Disk Capacity
2
30.000 GB
Add
Close
Help

Figure 13 Assigning additional virtual disks

After the virtual disks are assigned notice that the host group and its associated hosts are no longer under the default group in the topology. This completes the configuration.

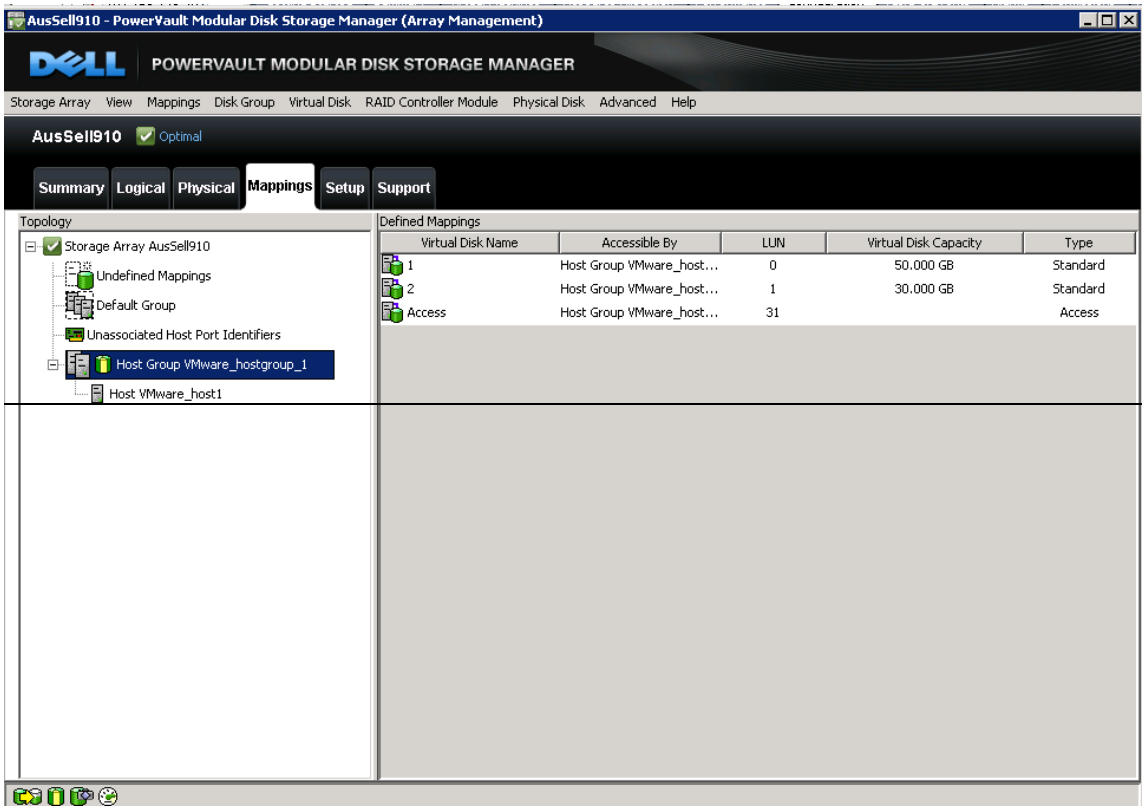


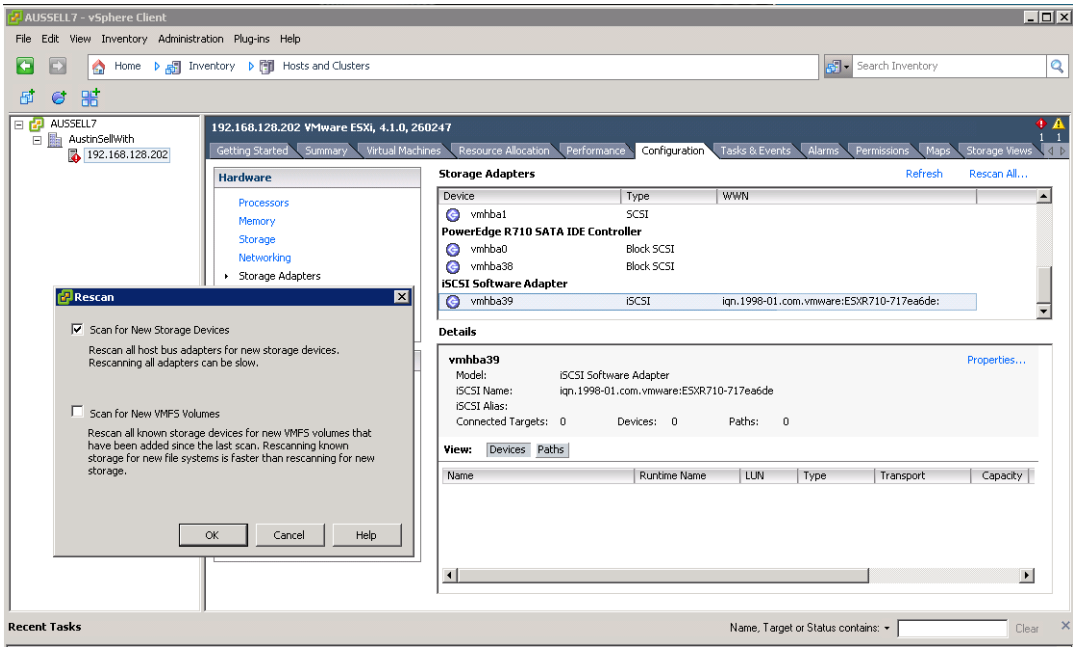
Figure 14 Completed Topology with Assigned Virtual Disks

STEP10: PERFORM RESCAN SO VMWARE SEES THE VIRTUAL DISK

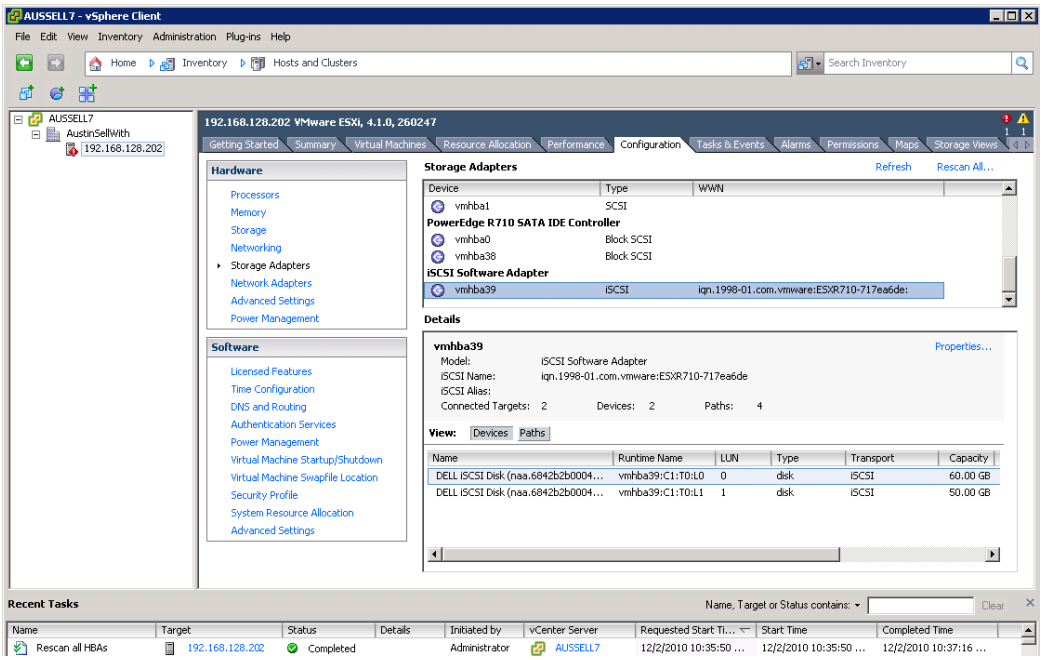
The next step is to connect to the volume on the SAN and verify the connection status. Since the iSCSI access and configuration was configured in the last step, the only thing to do now is to rescan the iSCSI Adapter and make sure the volume appears correctly.

In the vSphere4 GUI click on ***Configuration -> Storage Adapters*** and select the iSCSI Software Adapter.

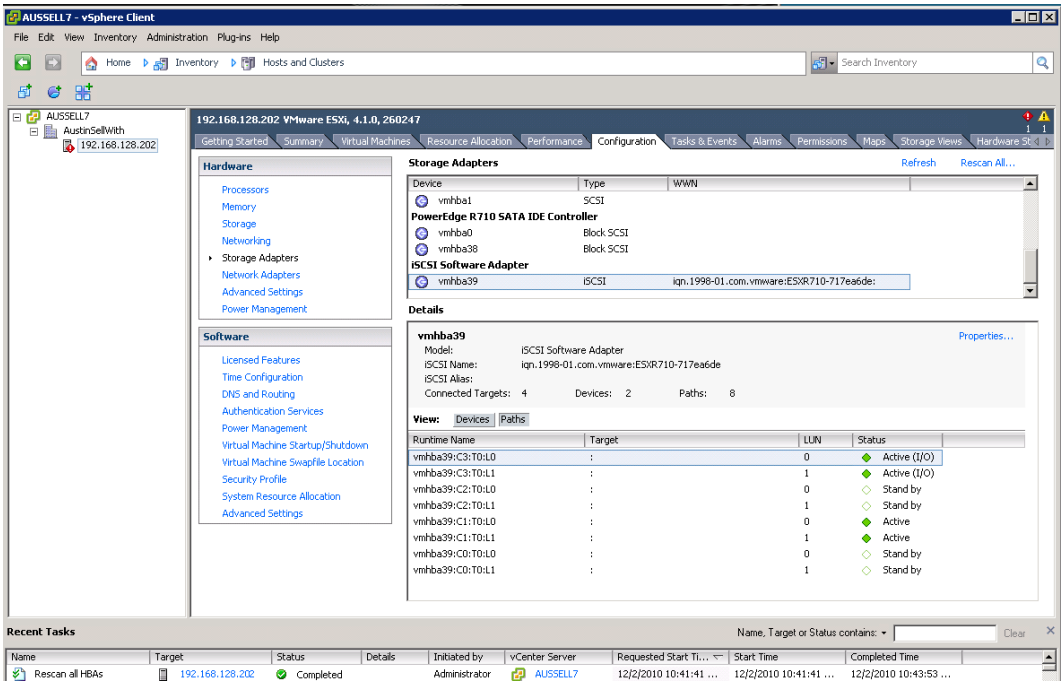
Click ***Rescan All*** and choose to Scan for New Storage Devices and select ***Ok.***


AUSSELL7 - vSphere Client
File Edit View Inventory Administration Plug-ins Help
Home Inventory Hosts and Clusters
Search Inventory
AUSSELL7
AustinSellWith
192.168.128.202
192.168.128.202 VMware ESXi, 4.1.0, 260247
Getting Started Summary Virtual Machines Resource Allocation Performance Configuration Tasks & Events Alarms Permissions Maps Storage Views
Hardware
Processors
Memory
Storage
Networking
Storage Adapters
Storage Adapters
Refresh
Rescan All...
Device Type WWN
vmhba1 SCSI
PowerEdge R710 SATA IDE Controller
vmhba0 Block SCSI
vmhba38 Block SCSI
iSCSI Software Adapter
vmhba39 iSCSI iqn.1998-01.com.vmware:ESXR710-717ea6de:
Details
vmhba39
Properties...
Model: iSCSI Software Adapter
iSCSI Name: iqn.1998-01.com.vmware:ESXR710-717ea6de
iSCSI Alias:
Connected Targets: 0 Devices: 0 Paths: 0
View: Devices Paths
Name Runtime Name LUN Type Transport Capacity
Rescan
Scan for New Storage Devices
Rescan all host bus adapters for new storage devices. Rescanning all adapters can be slow.
Scan for New VMFS Volumes
Rescan all known storage devices for new VMFS volumes that have been added since the last scan. Rescanning known storage for new file systems is faster than rescanning for new storage.
OK Cancel Help
Recent Tasks
Name, Target or Status contains:
Clear

If everything has been configured properly under Devices there will be new PowerVault iSCSI Disks with the correct LUNs, similar to what's shown below.



If the device information is correct select the Path Tab and verify that there are active and standby paths for each device (LUN)

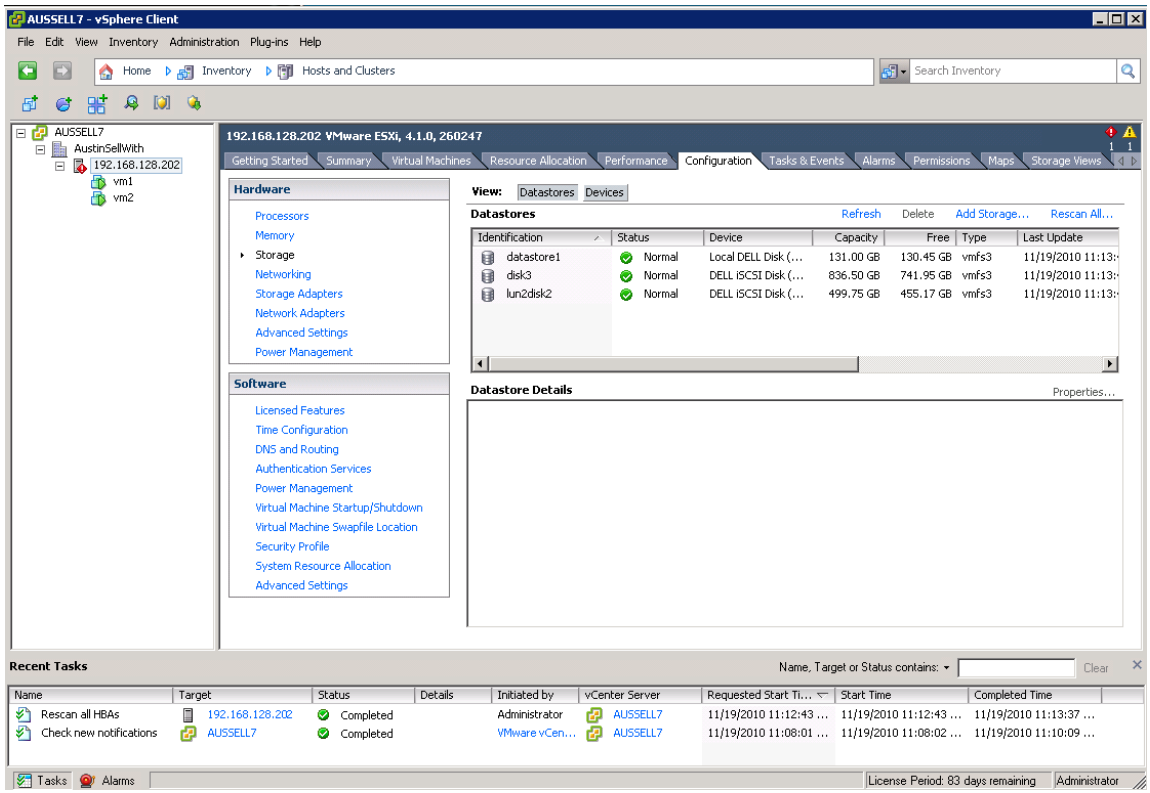


Repeat this step for each additional new Dell iSCSI disk that is created.

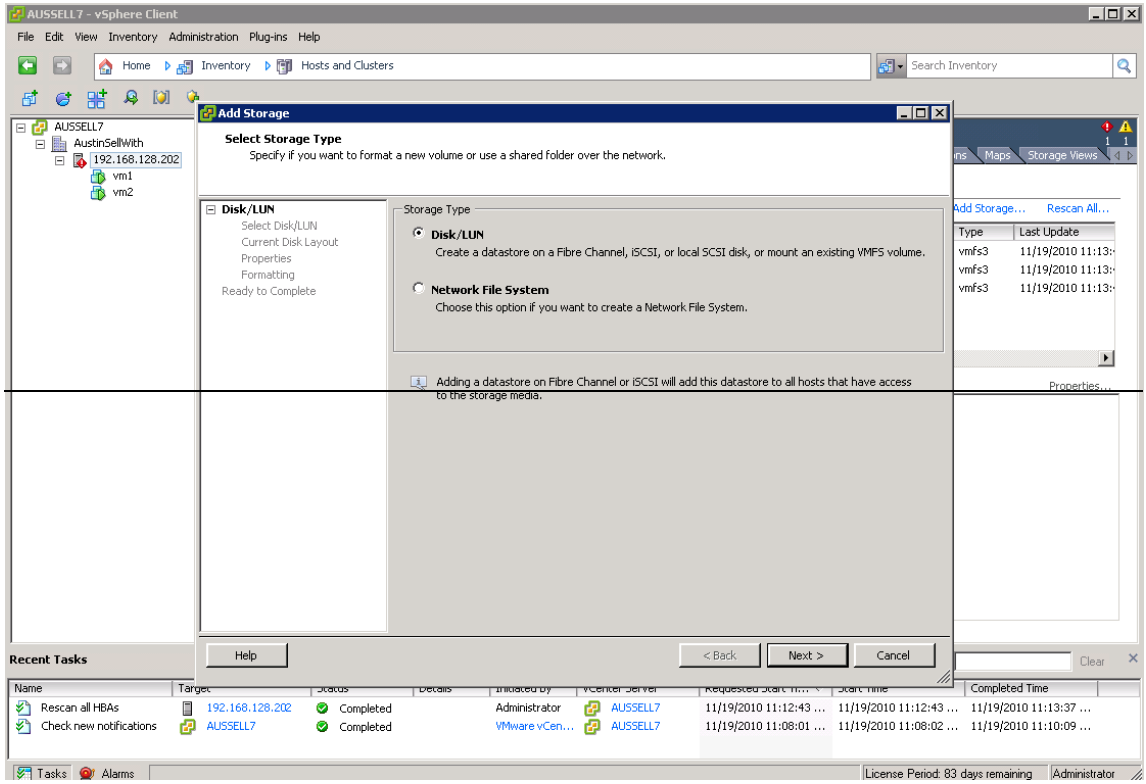
STEP11: CREATE VMFS DATASTORES

Now that the iSCSI Software adapter is set up and configured and the Dell iSCSI disks are visible to the adapter, they can also be formatted as VMFS Datastores and utilized as normal.

Creating a Data Store from the MD32xxi LUNS is the same as creating a Data Store with any local disk. Begin by selecting Storage under Hardware and then select *Add Storage*


AUSSELL7 - vSphere Client
File Edit View Inventory Administration Plug-ins Help
Home Inventory Hosts and Clusters
Search Inventory
AUSSELL7
AustinSellWith
192.168.128.202
vm1
vm2
192.168.128.202 VMware ESXi, 4.1.0, 260247
Getting Started Summary Virtual Machines Resource Allocation Performance Configuration Tasks & Events Alarms Permissions Maps Storage Views
Hardware
Processors
Memory
Storage
Networking
Storage Adapters
Network Adapters
Advanced Settings
Power Management
Software
Licensed Features
Time Configuration
DNS and Routing
Authentication Services
Power Management
Virtual Machine Startup/Shutdown
Virtual Machine Swapfile Location
Security Profile
System Resource Allocation
Advanced Settings
View: Datastores Devices
Datastores
Refresh Delete Add Storage... Rescan All...
Identification Status Device Capacity Free Type Last Update
datastore1 Normal Local DELL Disk (... 131.00 GB 130.45 GB vmfs3 11/19/2010 11:13:
disk3 Normal DELL iSCSI Disk (... 836.50 GB 741.95 GB vmfs3 11/19/2010 11:13:
lun2disk2 Normal DELL iSCSI Disk (... 499.75 GB 455.17 GB vmfs3 11/19/2010 11:13:
Datastore Details
Properties...
Recent Tasks
Name, Target or Status contains:
Clear
Name Target Status Details Initiated by vCenter Server Requested Start Ti... Start Time Completed Time
Rescan all HBAs 192.168.128.202 Completed Administrator AUSSELL7 11/19/2010 11:12:43 ... 11/19/2010 11:12:43 ... 11/19/2010 11:13:37 ...
Check new notifications AUSSELL7 Completed VMware vCen... AUSSELL7 11/19/2010 11:08:01 ... 11/19/2010 11:08:02 ... 11/19/2010 11:10:09 ...
Tasks Alarms
License Period: 83 days remaining
Administrator

Because an iSCSI disk is considered a local SCSI disk the storage type is Disk/LUN



Select one of the LUNS from the MD32xxi to create a Datastore from.

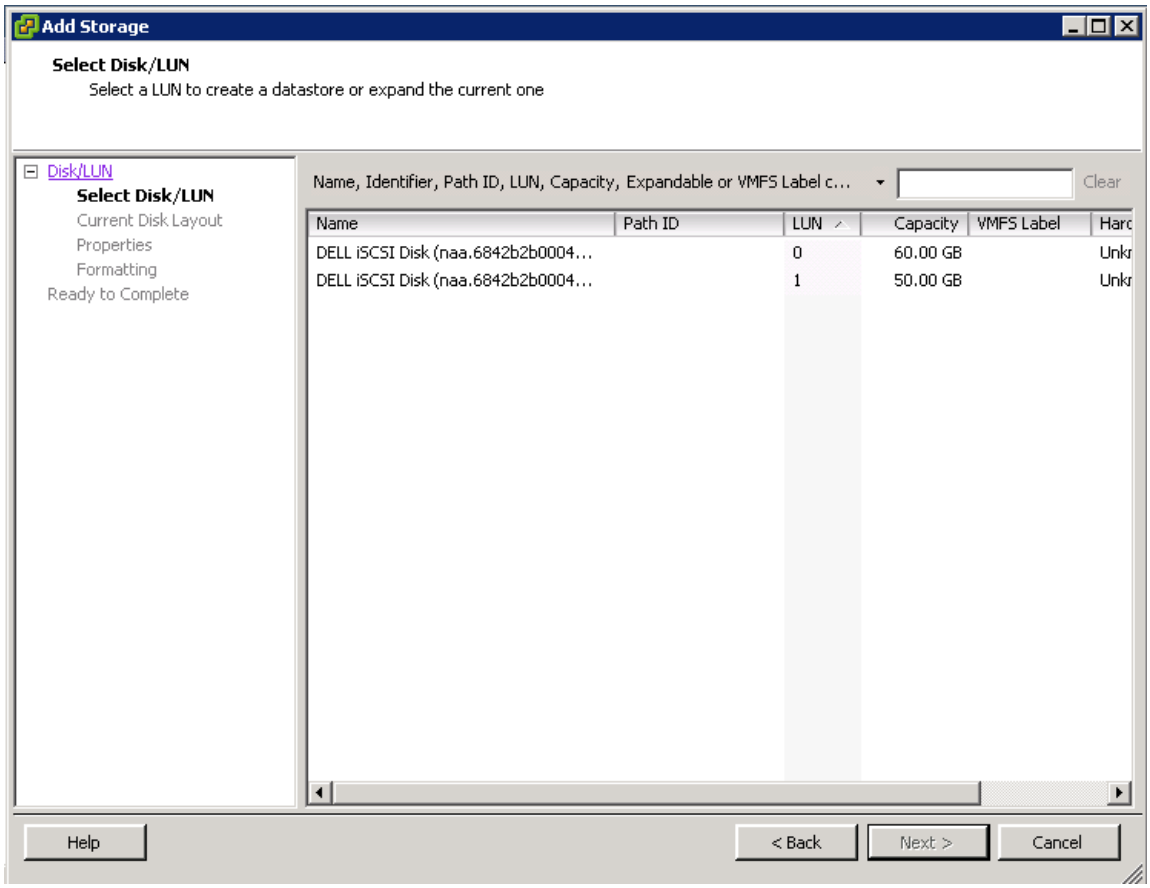


Figure 15 Selecting a LUN to create a Datastore

This screen displays the information about the disk layout. Select next to create a VMFS partition.

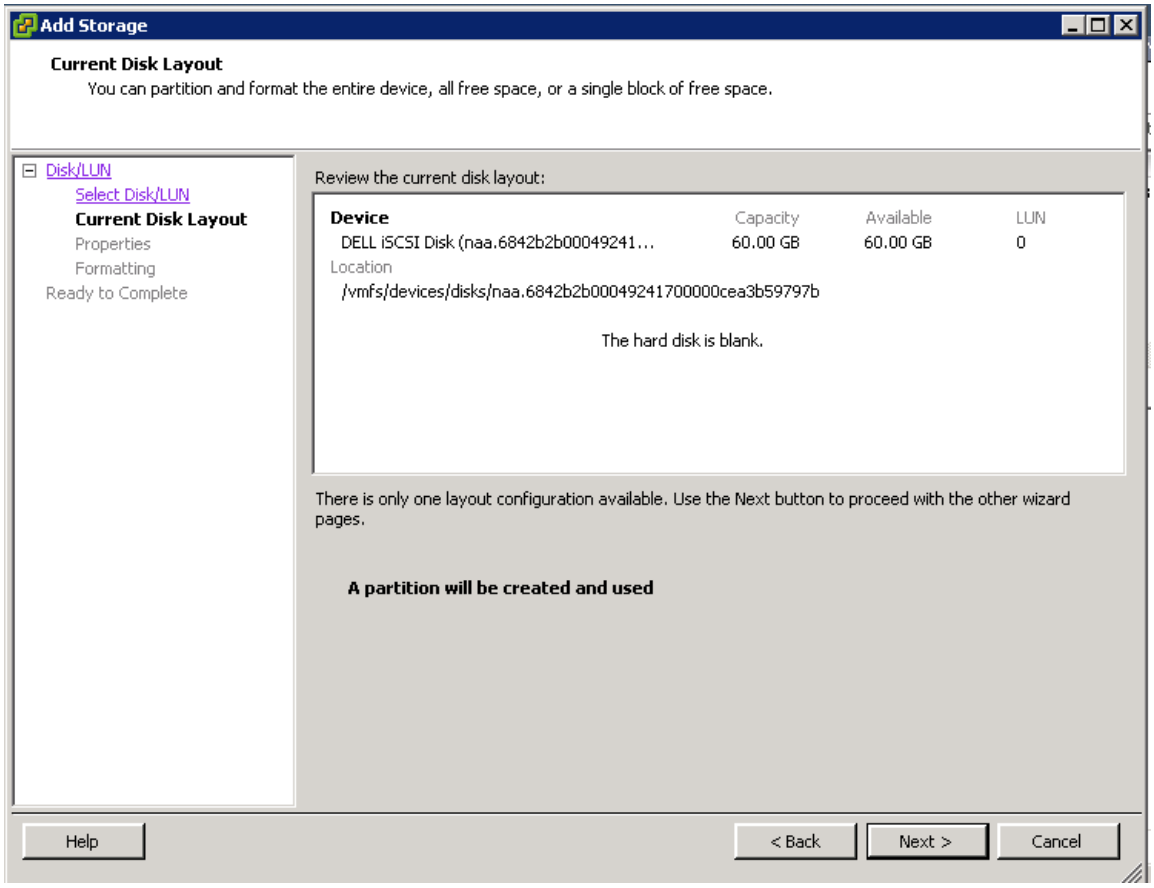


Figure 16 Disk Layout

Enter a Datastore name and select next.

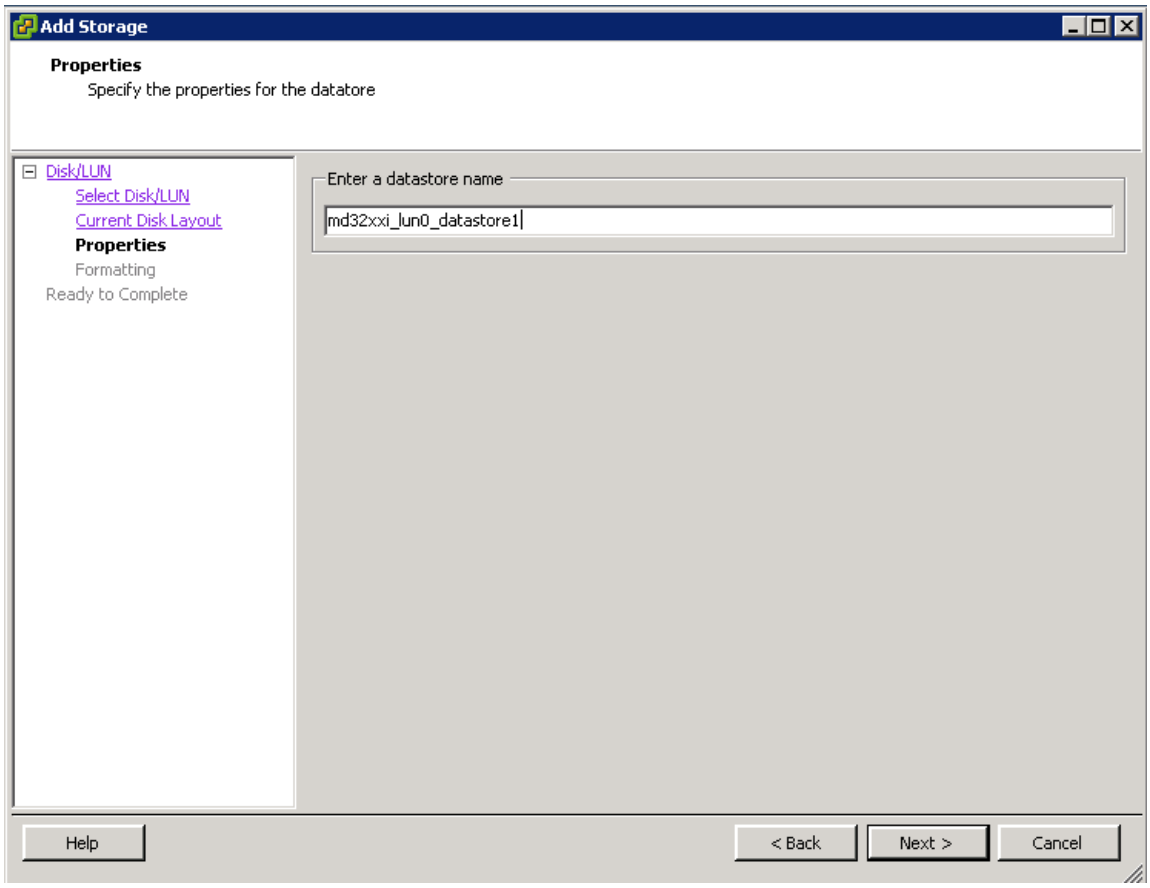


Figure 17 Datastore name

Adjust the Maximum file size as needed. For this example we used the maximum capacity. Select ***Next*** when finished.

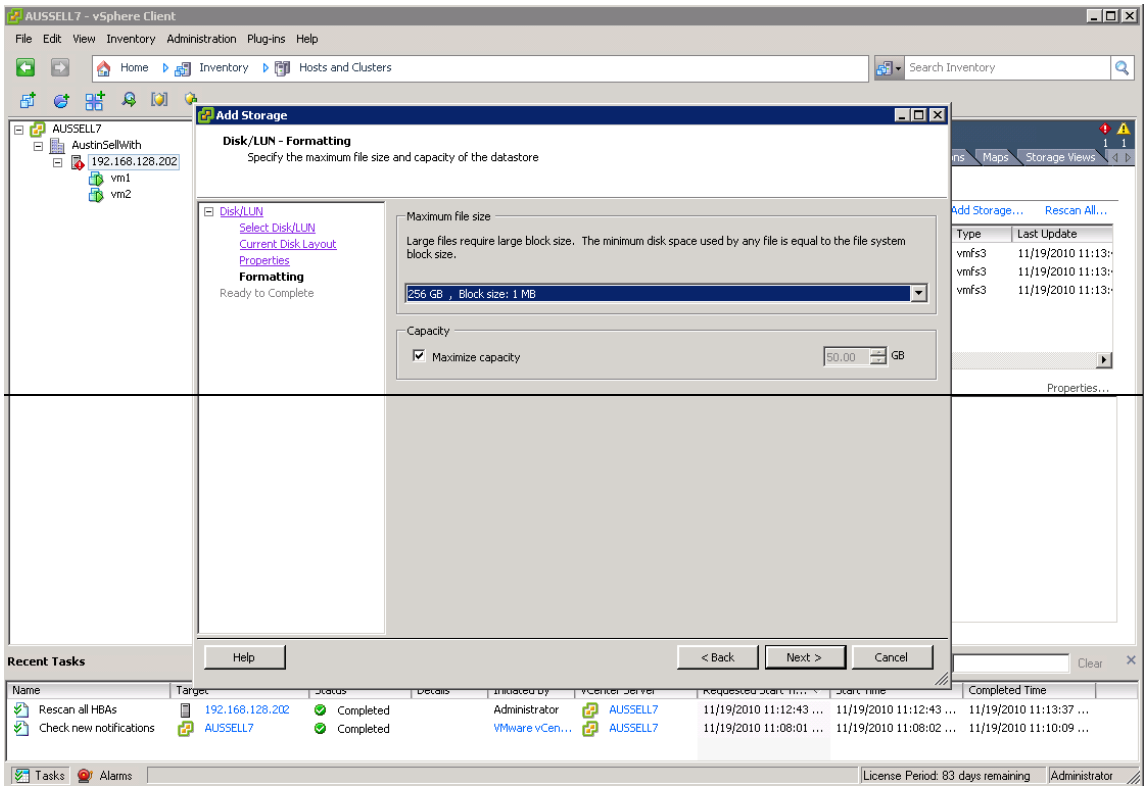


Figure 18 Maximum File Size

Review the disk layout and click ***Finish*** to add storage.

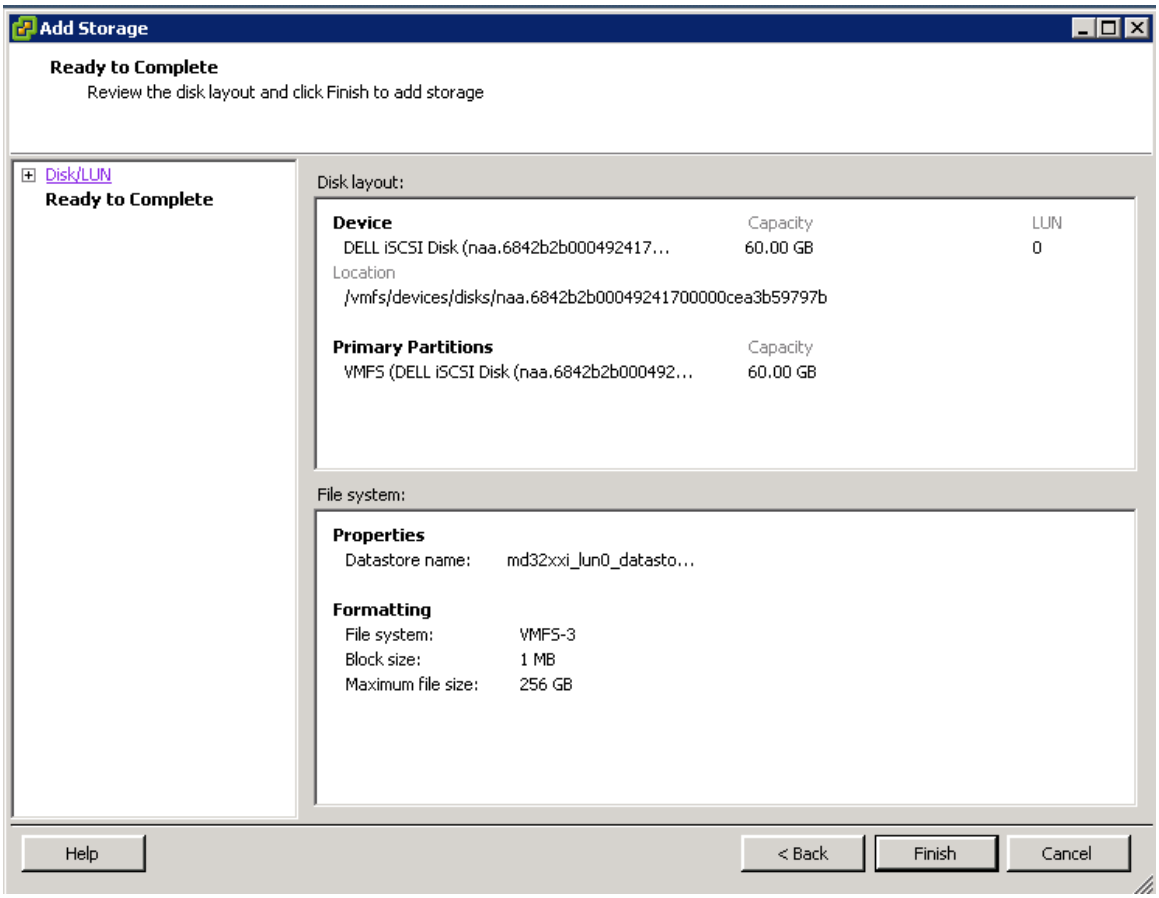
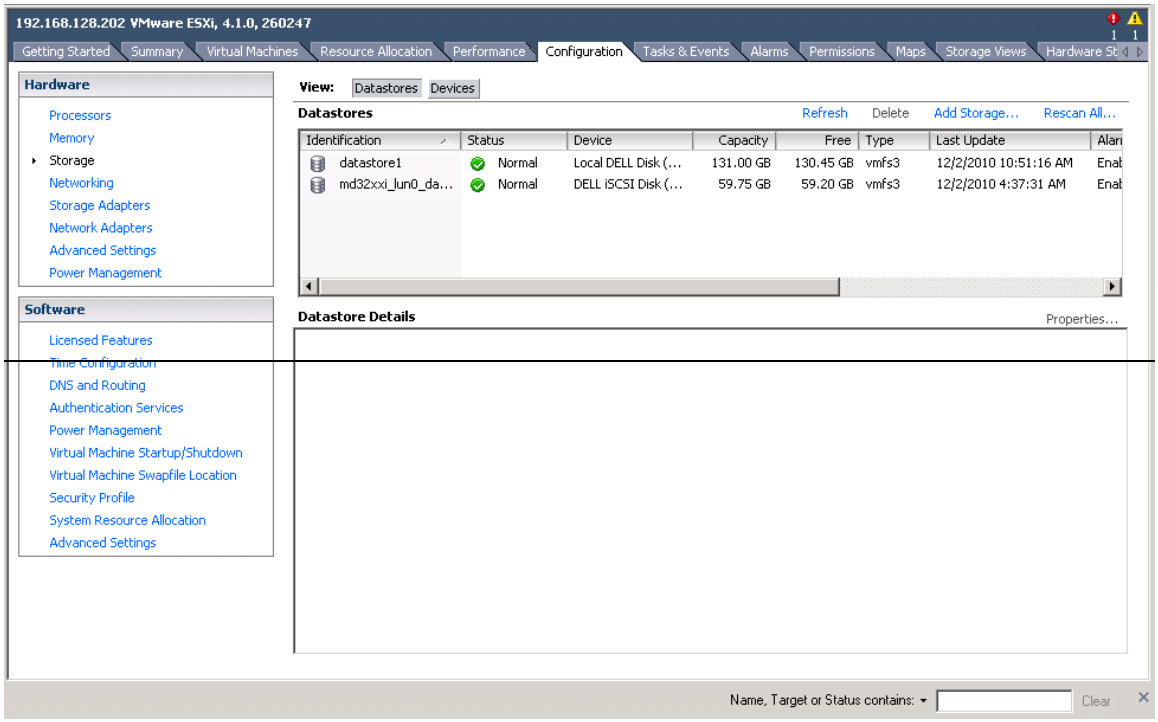


Figure 19 Review disk layout

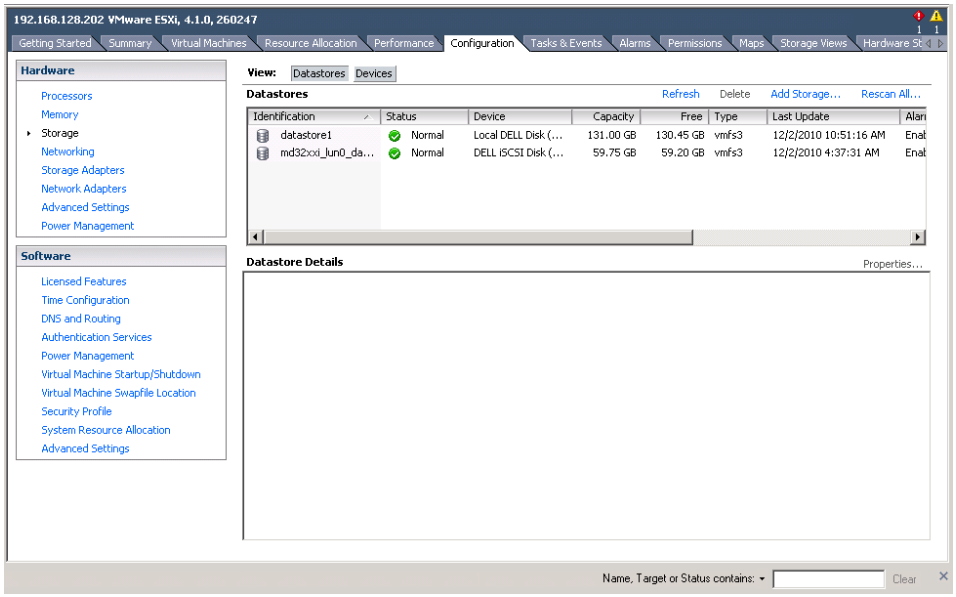
The new storage is completed and ready to use with VMs.



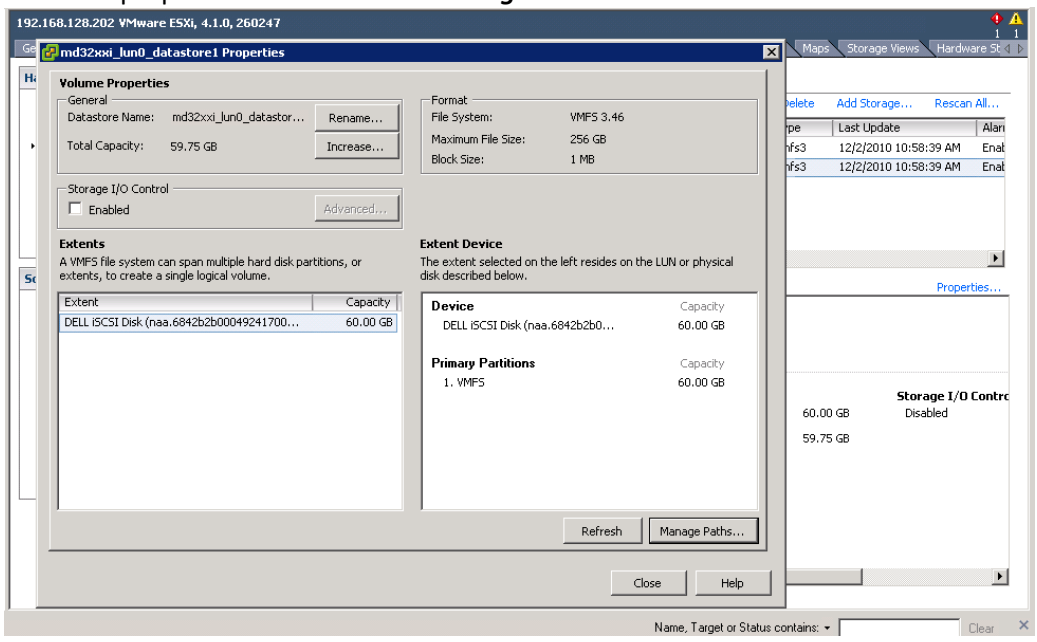
STEP12: CONFIGURING VMWARE PATH SELECTION POLICY

Features enabled by configuring the iSCSI Software Initiator the way we have is that now we can take advantage of several multipathing policies, such as Most Recently Used(MRU) and Round Robin(RR). This allows for greater and better bandwidth utilization than in previous versions of ESX.

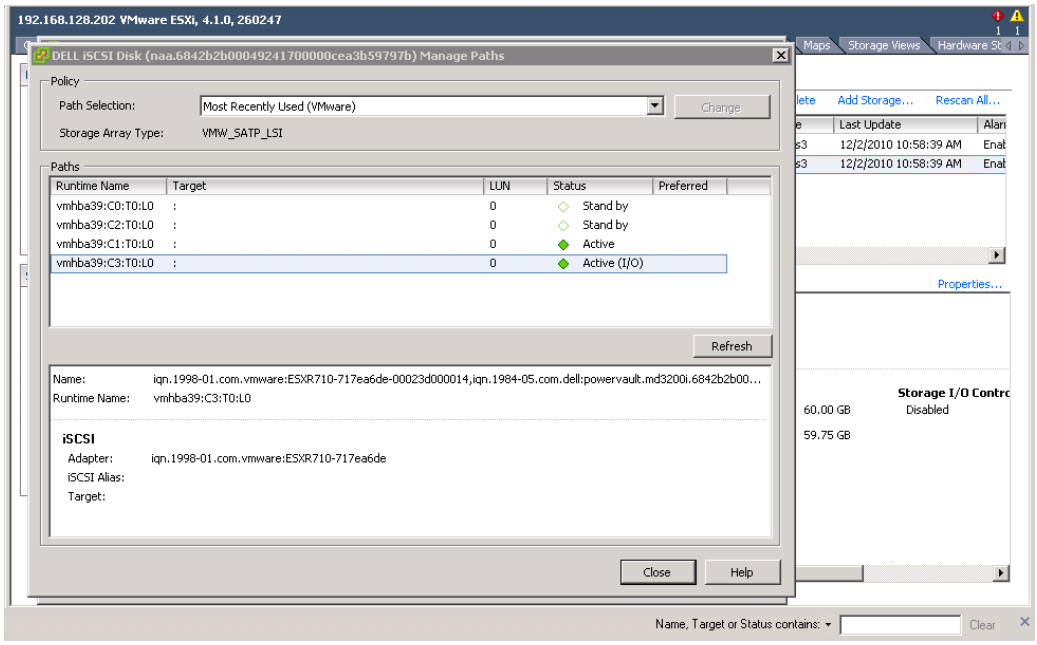
To verify the Path Selection Policy on a datastore, select the volume from the vCenter GUI. ***Configure -> Storage***. Highlight the datastore and select properties.



From the properties window select ***Manage Paths***.



The path selection can be either MRU or RR and the Storage Array Type should be VMW_SATP_LSI.



CONTACT INFORMATION

HTTP://SUPPORT.DELL.COM/SUPPORT/TOPICS/GLOBAL.ASPX/SUPPORT/PRODUCT_SUPPORT/PRODUCT_SUPPORT_CENTRAL?C=US&CS=555&L=EN&S=BIZ**References**

VMware vSphere 4.1 Documentation:

http://www.vmware.com/support/pubs/vs_pages/vsp_pubs_esxi41_e_vc41.html

Dell/VMware alliance home page:

http://www.dell.com/vmware

APPENDIX A

Steps for using the iSCSI Offload functions of a NIC

Lower CPU utilization and potentially lower power consumption justify offload adapters(a.k.a. h/w initiators).

With hardware-based iSCSI storage, you use a specialized third-party adapter capable of accessing iSCSI storage over TCP/IP(a.k.a. iSCSI Offload, ISOE adapters). This iSCSI initiator handles all iSCSI and network processing and management for your ESX/ESXi system.

The list of hardware initiators supported on the MD32xxi can be found here.

You must install and configure the hardware iSCSI adapter for your host to be able to access the iSCSI storage device. For installation information, see either Broadcom or Emulex documentation.

With respect to Broadcom NICs, this site from VMWare identifies 'Functionality Caveats', which include:

- Broadcom Hardware iSCSI does not support Jumbo Frames or IPv6.
- Dependent hardware iSCSI does not support iSCSI access to the same LUN when a host uses dependent and independent hardware iSCSI adapters simultaneously. This site gives further information regarding dependent & independent adapters. Dell support in this regard extends only to dependent adapters.

Considerations involving subnet configuration

Subnets should be allocated by the number of array ports per controller. With the MD32xxi you only get an active path to multiple ports on the same controller if they are on different subnets/vLANs. Since the MD3220i has 4 ports per controller you get your best throughput with 4 subnets.

On an MD32xxi, each disk group is owned by a controller, the LUNs are assigned out of those disk groups. Only one controller at a time has access to the LUNs. The alternate controller has access to those LUNs but only as a failover alternate path. This LUN/controller relationship is reported by the MD32xxi to VMware which then dictates the paths (and the "optimal" condition of the MD32xxi).

On the MD32xxi, setup each port on a different subnet with one disk group per controller, each disk group with 4 LUNS (one LUN per port).

Regardless of the pathing method in VMware, you will only have one active port on each controller of the array if you do not create additional subnets. Without additional subnets that will cause a bottle-neck at the controller since pathing is at the disk group level rather than the LUN level for the MD3xxxi

Configuring RR to the same LUN across both controllers is not recommended.

Here are the ESXi CLI commands to switch the pathing policy. You run this for each device. Note, this can also be accomplished via the GUI.

esxcli nmp device setpolicy --device < device name > --psp VMW_PSP_MRU
esxcli nmp device setpolicy --device < device name > --psp VMW_PSP_RR
esxcli nmp device list

The number of servers, and physical NICs as well as the I/O access characteristics will affect how you configure the MD32xxi. Performance depends on many variables. For example, if you have lots of random data going to one LUN and lots of sequential data on another LUN, you might want them to be on separate disk groups as all that random movement could inhibit performance of the sequential data. Now, if all the data is sequential, you might get better performance keeping both the LUNs on a large disk group and take advantage of spindles. So, a lot depends on the nature of your data.

A performance tuning guide that talks about various variables that you can play with and how each might impact performance is available here.

Using the MD Configuration Utility(MDCU)

This utility provides a wizard for configuring ports on an MD3xxxi. A user would employ this on a guest OS under an established VM.

Considerations involving Volume Not On Preferred Path

Virtual Disk Not On Preferred Path(VNOP) condition is the result of a Virtual Disk (a.k.a. LUN) being assigned to the alternate controller from its original assignment when first created.

This situation can arise as a combination of default settings for Virtual Disk creation in the MD32xxi and the creation of active iSCSI sessions between the host and the MD32xxi for iSCSI access. Insufficient active paths have been defined to allow multipath access preferred by the MD32xxi storage array for performance and redundancy features.

The difference between current path and MD32xxi preferred path can be a configuration issue, and in most cases is not a functional path or hardware failure. There are corrective actions possible to resolve the reported Virtual Disk Not On Preferred Path fault condition without replacement of any hardware.